RESOLUTIONS OF STATE OF IDAHO AND ENVIRONMENTAL PROTECTION AGENCY COMMENTS PLUS DISCUSSION OF ADDITIONAL CHANGES MADE IN THE WORK PLAN BY DOE

March 1992

State of Idaho Comments and Resolutions

RE: Review Comments on the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Test Area North (TAN) Groundwater Operable Unit (OU 1-07B)

1. Page V, paragraph 1 states that one of the reasons the INEL was placed on the National Priorities List (NPL) was due to the release of contaminants to the groundwater. It would be more accurate to say the site was placed on the NPL because contaminants exceeded the Safe Drinking Water Act MCL's at the drinking water taps.

   Resolution: The statement has been modified to reflect that one of the reasons the site was placed on the NPL was due to contaminants exceeding Safe Drinking Water MCL's.

2. Page VI, last paragraph states in part that "...process sludge that had built up in the injection well during its years of operation." This same phrase has been deleted from the Proposed Interim Action Plan because it has not been demonstrated that the sludge did in fact built up gradually in the well during its years of operation.

   Resolution: The phrase has been deleted from the executive summary.

3. Page 2-20, paragraph 4, Subsurface Geology. Eighty-five feet for the thickness of "individual flows," seems much too thick. Suggest checking reference; probably means flow unit of multiple flows.

   Resolution: Although the statement is accurate, it was clarified by saying "thicknesses of up to 85 ft".

4. Page 2-25, last paragraph states in part that: "The best transmissivity estimates range from a low of 400 ft^2/day in the TSF injection well..." The transmissivity (T) values are based on slug test data which incorrectly determine a hydraulic conductivity of 5.0 ft/day. As Table 5-2 indicates, the upper perforated zone of the TSF Injection Well straddles the water table. The perforated interval is from 180'-224' below land surface (bls) but the potentiometric surface is at 199' (bls). Consequently, the saturated interval (b') used to determine hydraulic conductivity (k) is only 45' not 81' as presented in the table. Tables 2-4 and 5-2 should also be revised to reflect this.

   Resolution: The saturated interval of 81 ft is correct based on a perforated interval of 180-244 and 269-305 ft with a potentiometric surface of 199 ft bls. The column for hydraulic conductivity has been deleted from Table 2-4 per DOE/State/EPA discussions on the use of transmissivities for the Work Plan.

5. Page 2-27, Section 2.1.6.5, Rate of Flow. The average contaminant migration velocity calculated by A. H. Wylie is 0.6 feet per day. This figure is based on, "arrival times at TAN well USGS 24." The figures used are 1,425 ft in 2,190 days. This is a time period of 6 years. The injection well was in operation from 1956 to 1972.

The groundwater contamination (VOC) was detected in the production well in 1987 (31 years after disposal started) as a result of monitoring for VOCs to comply with the Safe Drinking Water Act.

Clarification is needed. Was the contamination detected in USGS-24 before it was detected in the production wells? If so, when, by whom, and what was detected? This statement contradicts the Environmental Impact Analysis, page 3, which discusses a 30 year transport time.

<u>Resolution</u>: The pre-1987 data on USGS-24 was obtained from routine specific conductance tests done by the USGS on their wells at the INEL. We are not aware of any organic data prior to 1987. The discussion has been expanded to clarify the use of this technique for determining rate of flow (see revised Section 2.1.6.5).

6. Page 2-30. All water table maps which attempt to show the effects of pumping wells at TAN should also report the pumping rate (Q).

<u>Resolution</u>: Pumping rate has been added to the appropriate figures and/or figure legend (i.e. Figures 2-16a and 5-2a of the Work Plan).

7. Page 2-39, Table 2-6. Table refers to TSF Injection Well receiving paint thinner and <u>solvent</u> from the Maintenance Shop via sewage plant. Could this indicate disposal of <u>spent solvent</u> to the injection well, thereby inferring RCRA hazardous waste?

<u>Resolution</u>: Since documented uses of these chemicals cannot be identified, the section was modified to clarify the status of this material.

8. Page 2-44, last paragraph states that: "There is no specific information on the chemical characteristics of the evaporator condensate..." There were sludge samples collected and analyzed for at least radionuclides from the PM2-A storage tanks when they were decommissioned in 1981. This data should be included in the RI.

<u>Resolution</u>: Data were already given in Tables 2-10 and 2-11 (now 2-11 and 2-12). These data are for the sludge, no data on the condensates are available.

9. Page 2-48 Section 2.3.4. Reference is made to disposing 5-gallon cans of spent solvent to the clarifier pits, could this infer RCRA hazardous waste?

Resolution: Since documented uses of these chemicals cannot be identified, the section was modified to clarify the status of this material.

10. Page 2-48, Section 2.3.6. What type of process waste water went to the TAN-620 floor drains which ultimately went to the IET Injection Well?

    Resolution: Additional information was added to Section 2.3.4 (previously 2.3.6) to list the types of process water - boiler room wastes, floor drains, and possibly a photo lab.

11. Page 2-49, last paragraph. Are the T-710A and T-710B storage tanks also know as the PM2-A storage tanks? Didn't the long term storage tanks depicted in Figure 2-19 fill to capacity within several years of initial start-up of the Intermediate Level Waste Disposal System (TSF-09)?

    Resolution: The tanks did fill and were emptied by TAN personnel in the late 50's and early 60's. The waste was reportedly taken to the injection well and dumped according to personnel interviews. Section 2.3.6, p 2-61 has been modified to include a paragraph on this action. Other sections of the Work Plan that discuss uses of the injection well have also been modified to include the disposal of evaporator sludges.

12. Page 2-52, paragraphs 2 and 3 indicate that the sludge samples collected from the T-710A and T-710B (PM2-A?) storage tanks were analyzed for metals and radiologicals. Was any analysis done for organics?

    Resolution: No analyses were done for organics because this was not required at the time. A sentence was added to Section 2.3.6, p 2-61 to document this information.

13. Page 2-52, Section 2-4. Both the USGS and EG&G have claimed discovery of the VOC contamination in the TSF production wells. The date of April 1987 is stated here, while September 1987 is stated in the Environmental Impact Analysis. EG&G's drinking water monitoring program did not start until 1988.

    Resolution: The environmental impact analysis (now waste management plan) was corrected to April 1987. Samples collected in late 1987 were independent of the start of EG&G's drinking water program.

14. Figures 2-20 through 2-25 indicate, among other things, repeated sampling of USGS well #24. Given that this well has 3 perforated intervals, was each sampling event taken from the same interval?

    Resolution: Samples from USGS-24 were collected in or just above the top perforated interval.

15. Figure 3-1. Add Stoddard Solvent to the conceptual site model for the TSF and WRRTF Burn Pits.

    Resolution: Per DOE/State/EPA agreement, the TSF and WRRTF Burn Pits were deleted as a potential groundwater contaminant source for the RI/FS. Therefore, the burn pits have been deleted from Figure 3-1. The burn pits are being addressed as a FFA/CO Track 2 investigation in FY-92.

16. Page 5-7, paragraphs 1 and 3: Change "support" to "report."

    Resolution: The word support is correct in the context of the discussion/section and thus was not changed.

17. Page 5-16, Figure 5-3 should include an additional proposed monitoring well(s) midway between the TSF Injection Well and the GIN-5 well in the WRRTF area. This should provide coverage to the southwest portion of the contaminant plume.

    Resolution: An additional monitoring well has been added to the RI to provide coverage in the area indicated. See Figure 5-3 and Sections 5.3.1.1 and 5.3.1.2 (WP) and 2.2.2.1 (FSP) for revised well placement and supporting criteria.

18. Page 5-17 discusses the intent of using 2" diameter screen and casing for all proposed monitoring wells. At a minimum, 4" diameter wells should be considered.

    Additionally, Section 5.3.1.3 should include a proposal for sampling at least Corehole-2 (CH2) for the contaminants of concern. This well is strategically located within the contaminant plume and provides discrete sampling intervals at depths that are deeper than the existing or proposed wells.

    Resolution: All wells have been changed to 4" diameter wells. Corehole TAN-CH2 is completed with 3/4-in. pipe. Obtaining a representative sample is not considered feasible given the depth of the piezometers and the well construction materials. However, under the revised drilling, well installation (especially TAN-19 and TAN-23) and sampling program deep groundwater samples will be available.

19. Page 5-20, Section 5.3.1.5 describes slug testing and the use of "Stevens" water level recorders to be dedicated in some of the newly installed wells. It should be noted that the Stevens recorders cannot be adopted to 2" monitoring wells.

    Resolution: With the change from 2 to 4-in. diameter wells, the use of Stevens recorders is appropriate and thus this and other discussions of recorders have not been changed.

20. Page 5-21, paragraph 3 states that: " For the existing monitoring wells constructed by the USGS, the construction details and quality control procedures during the installation are not available..." Construction details for nearly all USGS wells in the TAN area are available. However, analytical support Level III for the chemical analysis and Level IV for the radionuclide analysis is acceptable.

    Resolution: This statement was only intended to say that detailed records are not always available for the USGS wells. The statement has been reworded to indicate this.

21. Page 5-23, Section 5.3.3 discusses possible contaminant sources at the TSF Burn Pit. It should be noted that in a document prepared by EG&G (February 1988 MAT Plan for TSF Burn Pit), it is stated that possibly 27 drums of Stoddard Solvent were disposed of in the Burn Pit. These constituents should be considered potential contaminants of concern.

    Resolution: Per DOE/State/EPA agreement, the burn pits were removed from the RI/FS. The issue of waste disposal to the pits will be addressed in a separate Track 2 investigation.

22. Page 5-23, Section 5.3.4, Water Level Measurements. During the Scoping meetings on August 8-9, 1991, it was pointed out that the available water level data was in question because of lack of control on the vertical datum. It was decided that a first order survey would be conducted to reestablish a common datum for the TAN wells until the vertical control points for the INEL could be reestablished by any survey in the RI/FS. A survey is needed because of the extremely low gradient in the TAN area, the difference of less than 1 foot could indicate a misleading groundwater flow direction. The Comprehensive Well Survey shows that about one third of the wells around TSF are surveyed to the MSL datum of 1929, about one third to the INEL datum and one third are unknown. The MSL datum of 1929 is 1.29 feet lower than the INEL datum. This issue needs to be resolved for flow modeling purposes. If a survey is planned it should be mentioned here; if a survey is not planned, the recommendation should be made to conduct such a survey.

    Resolution: The first order vertical survey that is planned for all wells on the INEL is now mentioned here and in the FSP.

23. Page 5-27, paragraph 2 states that: " Concentration density effects are not going to influence the movement of contaminants..." Consideration must, however, be given to density differences between the contaminants of concern and groundwater flow through fractures where little dispersion occurs.

    Additionally, paragraph 3 of page 5-27 indicates that the data available on water movement is not sufficient to indicate three dimensional movement of either water or contaminants. Recent information collected this past summer from on-site investigations indicates that preferential fracture flows within single boreholes do occur resulting in vertical gradients across the site. Consequently, a 3 dimensional groundwater flow and contaminant transport model would be appropriate.

<u>Resolution</u>: The section on Contaminant Transport Modeling (5.5.2) has been changed due to the completion and review of the Groundwater Code Selection Technical Memorandum. The Technical Memorandum has been added to the Work Plan as Appendix H and discusses concentration density effects.

Per discussion between DOE/EPA/State and as discussed in the Technical Memorandum, sufficient data are not available, nor does the groundwater system warrant a 3-dimensional modeling effort.

24. Page 5-34, Section 5.6.3.3.1 states that: "Groundwater is the initial source of contamination."

    Since the 1990 removal of 55 linear feet of sludge in the injection well resulted in substantial reductions of contaminants in surrounding wells and because little or no organic contamination was found in the water or sediments of the TSF Perc Pond, it would be safe to assume that the ode in the injection well is (was) the principal (initial) source of groundwater contamination.

    <u>Resolution</u>: The risk assessment section has been revised to be specific to the RI/FS and the statement as indicated has been deleted from the revision.

25. Page 5-46, paragraph 3 (Remedial Action Objectives), second to the last sentence states: "Exposure may be reduced through 'actions such as capping an area, limiting access, or providing an alternate water supply." Since an interim action has been proposed and a great deal of information exists relative to the specific contaminants, media of interest, exposure pathways, etc., much more specific Remedial Action Objectives (RAO's) need to be presented here.

    <u>Resolution</u>: The discussion of alternative development and screening (Section 5.9) has been revised to be more specific to groundwater contamination without limiting alternative evaluation.

26. Appendix D uses the Data Qualifier "B" extensively throughout the laboratory data sheets. However, "B" is not included in the list of Data Qualifier Definitions on page D-2.

    <u>Resolutions</u>: A revised Data Qualifier Definition list has been added to this Appendix and others.

27. Page 1-11, paragraph 2 of the Field Sampling Plan states that..."personal interviews provide little definitive information on the types and volumes of organic wastes disposed to the injection well."

This may not necessarily be the case. A detailed interview by INEL Oversight staff with EG&G personnel revealed very specific information regarding the presence of the sludge in the injection well. This appears to be more than "hearsay" information as the interview was conducted with the person responsible for the disposal of sludge to the injection well.

Resolution: A discussion has been added to Section 2.3.2 (WP) and p 1-11 (FSP) which provides estimates on types and volumes of organic wastes disposed to the well. Also see the discussion on the evaporator and condensate (Section 2.3.6).

28. Page 1-10, Section 1.5, Types and Volumes of Waste Disposed to the TSF-05 Injection Well. The statement, "the TSF Injection Well received the same sort of waste water later received by the TSF disposal pond," is misleading and probably false. There are significant differences between the sludge removed from the injection well in 1990 (Appendix B Work Plan) and auger hole analyses from the disposal pond (Appendix A Work Plan). Suggest this statement be substantiated or removed wherever it is found in the RI/FS.

    Resolution: The statement that the injection well and disposal pond received the same sort of waste water has been reworded.

29. Page 1-15, paragraph 2 of the Field Sampling Plan delete the sentence: "This sludge had gradually built up in the bottom of the well during regular operation." This same language has already been deleted from the Interim Action Plan.

    Resolution: The statement that sludge had gradually built up in the bottom of the well has been deleted/changed.

30. Page 2-3, Table 2-2, Data Quality Objectives,...: If groundwater elevations are to be measured to +- 1.01 ft the vertical datum needs to be at least as accurate. Need to reestablish common vertical datum with a first order survey.

    Resolution: A first order vertical survey is being initiated for all wells on the INEL and will include the TAN wells. The discussion on well surveying has been changed to clarify this both here and in Section 5.2.4 of the FSP.

31. Table 2-2, page 2A of the Field Sampling Plan. Recommend that Total Dissolved Solids (TDS) be incorporated with measurements for conductivity. Field instrumentation is available which calculates TDS from specific conductance. Additionally, TDS are a 2° Federal Safe Drinking Water Act parameter with a designated MCL associated with it. TDS are also an excellent input parameter for modeling groundwater contaminant plumes.

Resolution: Added total dissolved solids to field measurements (Table 2-2 of the FSP and Table 4-3 of the Work Plan).

32. Page 2-9, paragraph 3 of the Field Sampling Plan states that 6 wells will be completed in the Snake River Plain Aquifer such that 3 nested well pairs will be utilized in only 3 boreholes. While this approach may be technically feasible it may be impracticable and in the long run cost prohibitive for several reasons.

- Considering the fact that the proposed well pairs are to be constructed of 2" diameter casing and screen, the deeper well of the pair may be completed at depths of 500 feet or greater. At this depth and considering the water table elevation at the TAN, the performance of the 2" submersible pumps is questionable because of limitations with respect to lift capabilities.

- The proposed 2" monitoring wells will not accommodate the "Stevens" (continuous) water level recorders.

- The proposed 2" diameter wells cannot be utilized as pumping wells in future remediation activities. Considering the fact that the proposed well nests are in excellent locations for pumping in addition to monitoring the contaminant plume, careful consideration needs to be given to this aspect of the plan.

In light of the above factors, it would be more beneficial and cost effective to construct these monitoring wells with pumping (recovery) capability in mind. Because borehole diameter limitations exist with the dual wall, reverse air rotary drilling technique, it will be necessary to change the concept of the nested well approach to the cluster well approach. As such, an individual borehole for each shallow and deep well in the pair will be required. At a minimum, a 4" diameter well should be utilized.

Resolution: As a result of discussions between the DOE, the EPA and the State, and from an evaluation of available hydrogeologic data, seven monitoring wells will be drilled and installed as discussed in Sections 5.3.1.1 and 5.3.1.2 of the Work Plan and Sections 2.2.2.1 and 5.1.2 of the FSP. The program now calls for two cluster pairs (TAN-18 and TAN-19 and TAN-22 and TAN-23) and three single completion wells (TAN-20, TAN-21, and TAN-24). Four inch wells will be installed with tentative completion depths tied to the current understanding of the system (see Section 2.1.6.6-Work Plan).

33. Figure 2-2, page 2-11 of the Field Sampling Plan. As stated earlier (page 5-16), an additional well pair location is necessary midway between the TSF Injection Well and the GIN-5 well.

Resolution: An additional well (TAN-21) has been added along McKinley Boulevard.

34. Table 2A, page 2-13 of the Field Sampling Plan. Correct the Saturated Length of the TSF Injection Well and recalculate hydraulic conductivity (k).

Resolution: The saturated interval of 81 ft is correct based on a perforated interval of 180-244 and 269-305 ft with a potentiometric surface of 199 ft bls. The column for hydraulic conductivity has been deleted from Table 2-4 per DOE/State/EPA discussions on the use of transmissivities for the Work Plan.

35. Table 3-3, page 3-6 of the Field Sampling Plan indicates that the initial sampling and pumping test depth of wells TAN-22 and TAN-23 will be 350'. This is 100' shallower than the uppermost completion depth of TAN-22. Is this correct?

Resolution: Aquifer testing and sampling depths are identified in Table 3-3 and are correct.

36. Page 5-2, paragraph 1. If "teflon-based joint compounds" are to be used, suggest sampling joint compound to test for semi-volatile and volatile organic compounds. Most of the teflon based compounds on the market still contain some form of solvent and/or mineral oil.

Resolution: Statement for joint compounds has been changed to Molybdenum-based compounds with no petroleum constituents. This statement has been added to the drilling subcontract language as well.

37. Page 5-11, Section 5.2.1 of the Field Sampling Plan discusses the importance of a straight borehole and well. However, no deviation limits are established.

Resolution: Per discussion between DOE, EPA and the State, the intent of the deviation survey is to establish the deviation (if any) of the installed well. However, a clarification has been added that all casings will be "hung" (i.e. kept in tension) until grouted in place.

38. Page 5-15, paragraph 3 of the Field Sampling Plan discusses the use of Stevens (continuous) Water Level Recorders within the pumping influence of the TAN production wells. As stated earlier, Stevens Water Level Recorders cannot be adapted to 2" diameter monitoring wells.

Resolution: With the change from 2 to 4-in. diameter wells, the use of Stevens recorders is appropriate and thus this and other discussions of recorders have not been changed.

39. Page 5-17, paragraph 2 of the Field Sampling Plan discusses the preservation of VOA samples with 4 drops of HCl per 40 ml vial. Actually, EPA protocol calls for 2 drops (per 40 ml) 1:1 HCL. Table 6-1, page 6-8 of the FSP should be corrected to reflect this change.

Resolution: Preservation of VOCs will be to pH <2; reference to quantity has been deleted because this is determined by pH of the water.

40. Throughout the Environmental Impact Analysis section, units used in the risk assessment are mg/L for VOCs and pCi/mL for radionuclides. Since the drinking water standards are in ug/L and pCi/L these units should be used. To change the units from drinking water standards distorts the public perception of risk.

Resolution: Units have been changed to ug/l and pCi/l throughout the document.

41. Page xiii, paragraph 1 of the Environmental Impact Analysis states that: "Treated water would be released to the TAN Disposal Pond at rates up to 100 gpm under the interim action or reinjected into the aquifer or the disposal pond at rates up to 250 gpm under a RI/FS remedial action."

The interim action is limited to a pumping rate of less than 100 gpm because of the limited capacity of the TAN Disposal Pond. Consequently, if discharges up to 250 gpm were directed into the existing pond under the RI/FS, pond capacity would be exceeded unless major modifications to the pond were incorporated.

Resolution: The Environmental Impact Analysis has been modified to a Waste Management Plan and the section on RI/FS remedial actions has been deleted.

42. Section 2.1.1, paragraph 1 of the Environmental Impact Analysis describes a series of "pump tests" to be run on the injection well in 1993. The pump tests are described as a series of 10 tests each generating up to 1,000 gallons of wastewater for a total of 10,000 gallons to evaluate whether or not any significant contaminant sources remain near the well. Distinctions need to be made to clarify between a "pump test" and injection well sampling:

- A pump test is conducted to determine hydrogeologic properties of the water bearing unit or specific well capacities.

- The correct protocol for conducting sampling of a well to determine chemical properties is to purge the well of 3 to 5 casing volumes of water or until specific indicator parameters (i.e., temperature, specific conductance, pH, etc.) stabilize.

- If one considers the injection well casing to be 12" and standing water in the casing to be a minimum of 50 linear feet, this alone is a volume of 300 gallons. Consequently, to obtain a representative sample of groundwater from the injection well a minimum of about 1,000 gallons of water would need to be purged from the well.

This being the case, Section 2.1.1 should be changed to "Injection Well Sampling."

Resolution: Pump test has been retitled as contaminant source test to avoid confusion. Paragraph has been changed to clarify scope.

43. Section 2.2.4 of the Environmental Impact Analysis discusses several disposal options of treated groundwater under the RI/FS, the preferred option being that of reinjection via new injection wells approximately 1 1/2 miles south of the TAN Injection Well.

This, in fact, may not be a good option for several reasons.

- Direct reinjection of treated groundwater back into the aquifer would have to meet, at a minimum, all state and federal chemical ARARs for specific constituents.

- Direct reinjection of treated groundwater downgradient of the contaminant plume (south of the TAN Injection Well) and outside the influence of any active pumping (recovery) wells would mean that any trace constituents left in the treated effluent would be free to migrate further downgradient beyond the WAG-1 boundary.

It would be preferable, therefore, to discharge treated groundwater north of the injection well and contaminant plume, perhaps in the area of the IET via a newly constructed percolation pond or series of exfiltration galleries. Discharge of treated groundwater upgradient of the contaminant plume and recovery wells would provide the capacity for any trace constituents left in the effluent to be recaptured by recovery wells and routed through the treatment system.

Resolution: Section has been deleted. Waste disposal under the post - RI/FS remedial action will be addressed during the feasibility study.

ENVIRONMENTAL PROTECTION AGENCY REGION 10

REVIEW COMMENTS
DRAFT REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
AND ADDENDA FOR THE TEST AREA NORTH GROUNDWATER OPERABLE UNIT
AT THE IDAHO NATIONAL ENGINEERING LABORATORY

GENERAL COMMENTS

1. Throughout the Work Plan, reference is made to instances where a determination would have to be made whether or not additional information would be required to support the Work Plan (e.g., Section 3.2.3, page 3-7; Sections 4.3.2.2, and 4.3.2.3, page 4-13, and Section 5.3.2, page 5-21). Although these references are inconsistent with the focused nature of this RI/FS given previous scoping sessions, the text must clearly state that if these determinations are necessary, they will be made by the WAG managers.

   Resolution: References indicating that additional work may be required to support the Work Plan were deleted as noted in the comment and in other places in the Work Plan.

EXECUTIVE SUMMARY

2. Page v, paragraph 3

   For the purpose of consistency, the goal of the interim action should be revised to accurately reflect the goal as stated in the Proposed Plan.

   Resolution: The goal of the interim action as stated in the executive summary has been changed to be consistent with the Proposed Plan.

3. Page vi, paragraph 2

   The statutory and policy framework that affects development of the baseline risk assessment and the feasibility study is determined by EPA guidance documents As a result, the objective Of identifying a "generic approach" for performing these activities is inaccurate. Accordingly, the second Work Plan design statement should be revised to state the following:

   "Gather sufficient information to adequately and accurately characterize the potential risk from the TAN."

   Resolution: The second Work Plan design statement has been revised as recommended.

4. Page viii, paragraph 3

   The current risk associated with exposure to groundwater is inaccurately characterized as protective of human health. Rather, the actual current risk should be described as protective, provided that the treatment-system does not malfunction. Further, the current use scenario for risk calculations is based on no institutional controls.

In addition, an objective of the risk assessment involves developing reasonable maximum estimates of exposure for both current and future use conditions at a site. Accordingly, the statement limiting the exposure analysis to only future use should be deleted or otherwise revised as described.

Resolution: The current risk was revised to reflect that institutional responses are protective provided the sparing system does not malfunction. Further the current-use scenario was changed to reflect that risk evaluations will be based on a no action alternative (i.e. no institutional response action).

Exposure analysis has been revised to include both current and future use scenarios.

WORK PLAN

5. Section 1, page 1-1

The purpose of this RI/FS is to focus on the process of investigating and assessing remedial actions for the contaminated groundwater at TAN OU1-07B. It is not intended to address the other activities that are described in the INEL Action Plan. Therefore, to avoid confusion throughout the Work Plan and supporting documents, clearly describe:

A. the role of this RI/FS within the Action Plan; and

B. the procedure for incorporating information obtained from the TAN OU1-07A interim action into this RI/FS.

Resolution: To focus the RI/FS on the groundwater, activities planned under separate investigations (i.e. burn pits) were deleted from the Work Plan except for one reference and justification for "not including the burn pits" (Section 2.3 p 2-48).

6. Section 1.1, page 1-2

Delete the reference to CERCLA found in the last sentence of the last paragraph.

Reference: CERCLA has been deleted as recommended.

7. Section 1.2, page 1-4

Include the following as part of the regulatory history: INEL's NPL score (51.91) and the effective date of the FFA/CO (December 9, 1991).

Resolution: INEL's NPL score of 51.91 and the effective date of the FFA/CO have been included.

8. Section 2.0, page 2-I

Include an additional section that addresses previous - environmental response actions such as the installation of the air sparging system in the water storage tank and the removal of sludge from the injection well.

Resolution: The response actions are already mentioned in the Work Plan in several locations (Executive Summary; Sections 2.4, 2.4.2.2, 4.1.1 and 5.6). Therefore, no direct change to the Work Plan has been made.

9. Section 2.1.2, page 2-5

Although a detailed discussion of meteorological parameters and climatological statistics is not required, this section should include brief summaries of meteorological data such as precipitation, temperature, and wind speed.

Resolution: Section 2.1.2 has been expanded to include summary information on precipitation, temperature and wind speed.

10. Table 2-7, page 2-42

As appropriate, revise Table 2-7 to include radionuclides as suspected wastes.

Resolution: Radionuclides were added to the table as appropriate.

11. No comments provided.

12. Section 2.3.1, page 2-44

A. Include descriptive information regarding the "Industrial Waste Management Information System."

B. When referenced, it would be useful to describe, in general terms, the nature and applicability of DOE Orders.

Resolution: A) A description of the IWMIS has been added to Section 2.3.1, p 2-53.

B) References to DOE orders are very general and in specific cases, the context of the statement provides appropriate information. Titles were added were appropriate to provide additional clarification. DOE orders are also listed with number and title in the ARARs addendum.

13. Section 2.4, page 2-52

As previously stated, the purpose of this RI/FS is to focus on the contaminated groundwater at TAN OU1-07B. Therefore, this section should only present information related to the characterization of the groundwater contamination and not sites to be addressed by other investigations.

Resolution: To focus the RI/FS on the groundwater, activities planned under separate investigations (i.e. burn pits) were deleted from the Work Plan except for one reference and justification for "not including the burn pits" (Section 2.3, p 2-48).

14. Section 2.4.2.2, page 2-58

A summary table listing the sludge contaminant concentrations is needed.

Resolution: A summary table of sludge contaminant concentrations has been provided (Table 2-14).

15. Section 2.4.2.4, page 2-59

Include as an appendix, the lithologic logs for existing TAN groundwater monitoring wells.

Resolution: Available lithologic, geophysical, and well construction logs and diagrams have been added to Appendix E.

16. Section 4.2, page 4-5

A. The role of the baseline risk assessment is to address the risk associated with a site in the absence of any remedial action or control, including institutional controls. Therefore, institutional controls such as an air sparging system, may appropriately be considered in evaluating the effectiveness of a particular alternative, but not as part of the baseline risk assessment.

B. Institutional control of access for up to 100 years is inapplicable at TAN because land disposal of radioactive waste does not occur on-site and the objective of the investigation is ground water protection. Accordingly, the value of 30 years must be used for the future use exposure duration.

In lieu of 100 years of institutional control, provide one or more reasonable alternate estimations of the likelihood of institutional control (e.g., five, ten, or fifteen years periods) that will be used in developing the future use exposure scenario.

Resolution: Risk scenarios have been changed to evaluate a no action alternative" (see Sections 4.1.1, and 4.2).

The future use scenario will be evaluated after a period of institutional control. Institutional control will include the time period of current/planned programs plus facility D&D in compliance with 10 CFR 61.

17. Section 4.3, page 4-8

    In lieu of merely repeating the information contained in guidance documents, a description of the applicability of each listed element (e.g., data uses, data needs, PARCC) from the perspective of OU1-07B should be done.

    Resolution: Expanded discussions as appropriate or referenced Tables 4-2 and 4-3, which are designed to provide detailed information.

18. Section 4.3.1, page 4-9

    The intended data uses need to be prioritized. Otherwise, the distinction between appropriate analytical levels by data use is not apparent.

    Resolution: Reference was made to Table 4-3 which provides listing of intended data use (i.e., site characterization, risk assessment, engineering design etc.).

19. Section 4.3.3, page 4-13

    The known contaminants of concern need to be identified and their corresponding risk-based levels and analytical reporting limits.

    Resolution: Contaminants of concern have been identified verses MCL's and risk-based concentrations in Table 4-1.

20. Section 4.3.5, page 4-15

    As written, this section is confusing as to its relevance to the investigation.

    Resolution: This Section was out of place and was deleted.

21. Section 5.3.1.1, page 5-13

    Given the absence of an existing groundwater monitoring well in proximity of McKinley Boulevard, it may be advisable to install an additional monitoring well at this location to help determine the boundary of the contaminant plume. The exact location and screen depths should be based on a thorough evaluation of the existing data.

    Resolution: After reviewing existing hydrogeologic data and from comments and discussions with EPA and IDHW, well locations and completion depths were changed to obtain adequate site characterization data. Seven wells will be installed as discussed in Sections 5.3.1 and 5.3.1.2 of the Work Plan, and in Sections 2.2.2.1 (+ Figure 2-2 and Table 3-3) and 5.1.2 of the FSP. One of the seven wells planned for installation will be along McKinley Blvd.

22. Section 5.3.1.2, page 5-17

Given the concerns associated with nested well pairs (cross-contamination) and installation depths (alignment), cluster wells should be installed in lieu of nested well pairs.

In addition, a minimum of four-inch diameter groundwater monitoring wells should be installed in lieu of two-inch diameter wells, as these wells would allow more flexibility to borehole geophysics and potential pump testing or other studies.

<u>Resolution</u>: Two cluster wells pairs (TAN-18 & TAN-19 and TAN-22 & TAN-23) and three single completion wells will be installed. As recommended, 4-inch wells will be installed instead of 2-in wells.

23. Section 5.3.2, page 5-21

A. Delaying the first sampling event for a minimum of two weeks following well development appears unnecessary given the criteria listed in the SAP.

B. Include a discussion of data, such as that derived from well hydrographs, demonstrating that seasonal fluctuations in groundwater contaminant concentrations and hydraulic characteristics would be determined by two sampling events separated by approximately three months.

<u>Resolution</u>: A. The statement delaying the first sampling event has been deleted.

B. Hydrographs showing seasonal water level fluctuations are provided in Appendix F of the Work Plan. Sampling of the groundwater wells was changed to April and October to correspond to high and low seasonal fluctuations, respectively (see Section 5.3.2 of Work Plan).

24. Table 5-5, page 5-33

Although the intent of the summary information presented in Table 5-5 is useful, the format of the table does not fully document the exposure pathway analysis. A more desirable format would include the following: potentially exposure population (current and future land uses) and exposure route, medium, and exposure point.

<u>Resolution</u>: Table 5-5 has been revised to show the requested information.

25. Section 5.6.3.1, page 5-30

The INEL personnel and visitor exposure factor of one month should be revised to be consistent with the 250 day/year industrial RME exposure factor for Superfund human health risk assessment.

Resolution: A RME of 250 days/yr has been added to the risk assessment discussion in Section 5.6.1.

26. Section 5.6.3.2, page 5-31

The discussion of exposure pathways should clearly indicate why direct contact with the sludge and the burn pit soils are not considered to be complete exposure pathways.

Resolution: The discussion of exposure pathways has been expanded to clarify why the sludge is not considered with respect to a direct contact exposure route (mainly because of the limited time of exposure). Also, because the burn pits have been deleted from the Work Plan as a potential source, they will not be considered in the risk evaluation for the groundwater RI/FS.

27. Section 5.9, page 5-43

Given the current understanding of available data and the limited number of practicable remedial actions available for groundwater contamination, the preliminary identification of remedial action alternatives could be included in the Work Plan.

Developing preliminary remedial action alternatives at this time has the following advantages: defining the degree of detail necessary in delineating the extent of groundwater contamination; identifying data needed for evaluating remedial action technologies; and identifying action-specific ARARs that may influence the scope of RI activities.

The remedial action alternatives developed at this time would be refined throughout the RI/FS. In addition, although these alternatives would direct the site characterization activities and would form the basis for the FS, they do not necessarily have to limit the alternatives considered later in the FS.

Resolution: Preliminary remedial action alternatives have been included in the discussion to be more specific to the groundwater RI/FS.

28. Appendices

Insert a divider/tab for each appendix.

Resolution: Tab sheets have been added for each Appendix in the Work Plan.

29. Appendices A, C, and D

The analytical methods and detection limits used should be discussed.

Resolution: Analytical methods and/or detection limits have been added for data presented in Appendix A, C, and D.

30. No comment provided.

QUALITY ASSURANCE PROJECT PLAN

31. Table 5-1, page 5-2

The "radiochemical analysis procedure" is not described and should be.

Resolution: The general term was deleted and replaced with the titles of the specific procedures.

32. Section 10, page 10-1

A. To provide a frame of reference, INEL's procedures for data reduction, validation, and reporting should be compared against with EPA's procedures for the same.

B. A description on how samples sent off-site will be validated is needed.

C. A description of the data validation requirements for radionuclides is needed.

Resolution:
A. INEL's procedures were developed using EPA's procedures and are comparable.
B. A sentence was added stating that standard INEL data validation procedures will be used for off-site data.
C. A sentence was added stating the title of the INEL procedure for validating radionuclide data.

33. Appendix A, page A-I

Detection limits should in part be based on risk based calculations. We recommend that media specific risk-based concentrations for all contaminants of concern (including radionuclides) be calculated, and the appendix revised to include a tabular comparison between contaminant detection limits and media specific contaminant risk-based concentrations.

Resolution: A list of contaminants of concern has been provided along with appropriate MCL's and risk-based concentrations.

COMMUNITY RELATIONS PLAN

34. Section I.1, page I.1

It would be beneficial to inform the public that community relations is a team effort, involving the collaboration of DOE, IDHW, and EPA.

Resolution: The CRP has been modified in several areas to add IDHW and EPA as part of community relations effort.

35. Section 1.2, page 1-1

The interdependencies between the INEL Community Relations Plan (CRP) and the TAN CRP are not clearly described. For example:

- Dissimilarities between the installation-wide (INEL) CRP and site-specific (TAN) CRP regarding Community Background are not explained. Although the installation-wide CRP fully discusses Community Background, the site-specific CRP is limited to Community Profile. There is no discussion of other background components such as community involvement or key community concerns that might be unique to TAN.

- There are no apparent mechanisms: for conducting a site-specific (TAN) CRP or updating the installation-wide (INEL) CAP; or for ensuring consistency and identifying interdependencies between the site-specific CRP and the installation-specific CRP.

Resolution: Section 1.2 was modified to add connections between TAN CRP and sitewide CRP on both modifications and background information.

36. Section 2.0, Page 2-1

In lieu of a general reference to the RI/FS work plan, such as found in Section 2.1 and Section 2.3, it would be more beneficial to provide a specific reference.

Resolution: Section 2.0 was modified to call out Section 2 of the RI/FS Work Plan.

37. Section 3.3, page 3-4

This section must be revised to clearly state that DOE has chosen to integrate NEPA values into the CERCLA process pursuant to DOE's current policy and that such integration will not interfere with full and timely performance of DOE's CERCLA obligations.

Resolution: Section wa revised to state that DOE policy is to incorporate NEPA with CERCLA.

38. Section 5.0, page 5-1

As written, the generic nature of this section (i.e., examples of community relations activities) lends itself to inclusion in the installation-wide CRP, as opposed to the site-specific CRP.

It would be more beneficial to focus on those activities directly related to TAN and in so doing, to revise Table 5-1 to identify both the approximate timing of activities that are conducted routinely throughout the RI/FS and specific milestones. (Refer to Exhibit 3, page B-16, of the draft community Relations In Superfund: A Handbook [U.S. EPA, Interim, June 1988].)

Resolution: A new Figure was added (Figure 5-1) that shows the schedule of planned community events similar to the diagram in the EPA reference.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

39. Table of Contents, page iii

The category of "To-Be-Considered Material" is mistakenly referred to as "Advisories To Be Considered."

Resolution: EPA comment 39 was added to the document as recommended.

40. Table 3-4, page 3-6

Delete the statutes categorized as "Not ARAR" and the column titled "Not ARAR."

Resolution: EPA comment 40 was added to the document as recommended.

41. Table 4-1, page 4-2

A. Delete the statutes categorized as "Not ARAR" and the column titled "Not ARAR."

B. Executive standards are not enforceable standards. Therefore, Executive Order 11543 should be transferred to Table 6-1.

Resolution: EPA comment 41 was added to the document as recommended.

42. Table 5-1

A. Delete the column titled "Not ARAR."

B. OSHA should be deleted as a potential action-specific ARAR. OSHA standards are essentially workplace standards, designed to cover occupational exposures. Such standards apply of their own force, not through the CERCLA process.

C. CERCLA should be deleted as a potential action-specific ARAR.

Requirements of the NCP apply directly to all CERCLA response actions.

Resolution: EPA comment 42 was added to the document as recommended.

43. Section 6, page 6-1

"To-Be-Considered Material" is mistakenly referred to as "Advisories To Be Considered."

Resolution: EPA comment 43 was added to the document as recommended.

44. Table 7-1, page 7-2, -3, and -4

For the purposes of brevity, it would be useful to delete ARARs categorized as "Not ARAR" and the column titled "Not ARARs."

Resolution: EPA comment 44 was added to the document as recommended.

ENVIRONMENTAL IMPACT ANALYSIS

45. Section 1.2, page 4

The limited discussion of the integration of NEPA values into the CERCLA process should be expanded and placed at the beginning of this appendix. In particular, it should be clearly stated that NEPA's integration into the CERCLA process is a matter of current DOE policy, not EPA's and that such integration will not interfere with full and timely performance of DOE's CERCLA obligations.

In addition, EPA is not reviewing this document pursuant to the requirements of NEPA. NEPA is not a component of the CERCLA process as required by the National Contingency Plan and INEL Action Plan.

Resolution: Section was revised to state that DOE policy is to incorporate NEPA with CERCLA.

HYDROGEOLOGICAL COMMENTS

Work Plan

GENERAL COMMENTS:

1. The existing data has not been evaluated, especially water elevation data. There are no tables which compile water elevations for various wells from the prior investigation. The cross sections provided in the Work Plan do not incorporate available geophysical logging data to support the' interpretation given. The ground water contour maps do not include all the available wells and some wells are not properly located by nearly 1,000 feet compared to other maps. The month of December 1990 has the most water elevation information, but no contour map was developed for this period. There is no discussion for why the TAN 12 and CH 25 wells have such different water elevations compared to other nearby wells. Without support from prior work, there is no reason to accept the hydrogeological interpretation presented in the Work Plan, nor the' proposed plan for acquiring more data.

   Resolution: Water elevation data is provided in Appendix F and the appendix has been expanded to include (monthly) potentiometric maps. Water table data is also discussed in Appendix H "Groundwater Code Selection".

   Available geologic - geophysical well construction data for USGS and RFI wells have been compiled in Appendix E in a format which lends itself to evaluation.

   Varying water elevations, are discussed in Section 2.1.6 which has been expanded and updated

   Figures depicting well locations have been updated to reflect accurate locations as opposed to the schematic maps provided.

SPECIFIC COMMENTS:

2. Figure 5-2b (Figure 2-15b)

   The water elevations at the CH 2 cluster indicate substantial vertical differences in head which could drastically affect the contouring. Well data for TAN wells 9, 10 and 11 were not included on the map. Further the contour interval of 1 ft is not appropriate. If a tenth foot contouring is performed, the flow directions are to the north and northeast towards TAN 1. TAN 10 is not properly located as it should be 700 ft south of the depicted location. TAN 9 is located between TAN 10 and DISP 2 with a higher head than either indicating the potential for a mound under the lagoon. Unless substantially changed to address the concerns raised above, this map is of little value as an indicator of where to locate new wells.

   Resolution: As stated in comment 1, well locations on provided figures have been updated.

A discussion of head differences has been included as a new section (2.1.6.6) and provides the current hypothesis for explaining head differences.

Contour intervals have been changed to a more appropriate scale.

3. Figure 5-2a (Figure 2-15a)

TAN 10 is not properly located compared to Figure 2.2. If the GIN wells head data is considered in drawing the contours, the 4583 contour line would need to swing 3,000 feet to the southeast into the GIN well area before returning to the capture zone around TAN 1.

Resolution: TAN-10 is properly located on Figure 2-15a (now 2-16a) and 5-2a but was not accurate on Figure 2-2. Figure 2-2 has been updated to be more accurate.

4. Figure 2-2, 2-26, 1-13 FSP

The location of the TCE plume ignores the non-detection of TCE at well cluster TAN 8 and 17. This information suggests that the TCE plume divides east and west of the area. This would be consistent with the water elevation data from CH2S, TAN 8 and TAN 12.

Resolution: The TCE plume boundary has been updated and along with a more accurate placement of wells on the Figures, is consistent with the data.

5. Page 2-20

There is a discrepancy in the discussion of individual basalt flow thicknesses as compared to page 2.17.

Resolution: Page 2-17 has been changed to read thickness up to 85 ft, which is true. Page 2-20 talks about individuals flows (median thickness) and is also correct (and perhaps more common).

6. Page 2-25

The raw data from the pump tests should have been included in an appendix to allow evaluation. It is unclear as to the basis for making corrections to the data to address partially penetrating wells.

Resolution: Appendix J has been added to include the raw data from the pump tests.

7. Page 2-23, Section 2.2.6.6

Vertical flow is dismissed without justification. There is no consideration of the last flooding of the playa from Birch Creek nor how water elevations in TAN 15 and 16 could have been affected by a 3 to 4 ft head difference that seasonally occurs in the TAN area. No evaluation of how difference in hydraulic conductivity (as minor as 0.06 ft) at TAN 15 and 16 could cause the observed head differences. Also, the 11 ft head difference between CH-2s and TAN 8 is not addressed, nor is the 12 ft head difference between TAN 11 and 12. There is an 11 ft head difference between CH-25 and 2D which needs to be explained. A discussion of these discrepancies is necessary to avoid wasting resources in locating new well clusters to fine tune our understanding of the area hydrogeology to develop remediation strategies.

Resolution: Vertical flow and head differences are discussed in a new Section 2.1.6.6 and are also discussed in the "Groundwater Code Selection Technical Memorandum" (Appendix H).

8. Page 2-35

A water budget would be very helpful in understanding how pumping and recharge affect observed water elevations in nearby wells.

Resolution: A water balance has been included in Appendix I.

9. Section 3

The assumption that the lateral extent of contamination is known is dependent upon knowledge of the hydrology of the area. Based on above discussions, more interpretation of existing data is necessary to support such a premise.

Resolution: Statements of known lateral extent have been restricted to the north, east, and west boundaries of the plume. Based on a more detailed review of available data and from discussions with the EPA, the south, southeast, and southwest boundaries need to be defined during the RI.

10. Page 4-7

The accuracy of the modeling predictions needs to be assessed - to be of value. Data needs to support modeling efforts needs to be fully discussed in Section 4.30 and is not.

Resolution: The accuracy of modeling predictions will be assessed through sensitivity analyses as discussed in Appendix H "Groundwater Code Selection."

11. Table 4-3

If possible, continuous core from each new well cluster should be obtained. Also, for each new well, a complete round of geophysical parameters should be obtained (i.e., K, Na, Ca, Mg, NO3, 504, CO3, HCO3, Fe and Mn).

Resolution: Per discussions with the EPA and State, the heterogeneity of the Snake River Plain basalt would not warrant continuous coring during the RI. Geochemical parameters as stated have been collected in past sampling events and are also planned for RI sampling efforts.

12. Page 5-21

There are an insufficient number of wells in the GIN area or around other satellite areas to determine if the existing monitoring wells are downgradient of the potential sources of contamination at these areas. The regional flow pattern suggests 12 that there are no downgradient wells in the GIN area.

Resolution: A remedial investigation well (TAN-24) has been sited down gradient of ANP-8 at WRRTF.

13. Page 5-26, Section 5.5.2

The Martineau modeling used in 1991 needs to be discussed in the Work Plan, especially how the model accounted for the effects of pumping and recharge areas.

Resolution: The Martineau method used a steady state model. The modeling effort is discussed in the Technical Memorandum for Groundwater Code Selection (Appendix H).

14. Page 5-27

The statement that mixing of contaminants is essentially complete does not fit with the available data and well construction information. TAN 15 and 16 are not immediately downgradient, but rather over 3,000 ft southeast of TAN. As the TSF injection well spans the aquifer above and below the interbed, the question of whether the interbed is continuous is of little significance.

Resolution: The specific statement has been deleted. Mixing is discussed in Appendix H, the Technical Memorandum for Groundwater Code Selection.

15. Page 5-28

The issue of heterogeneity within the simulated domain needs to be elaborated upon as the scale of the modeling area will determine the importance of aquifer heterogeneities. This in turn will determine the type and amount of aquifer data necessary to model the site. Based on work performed by USGS, the SRPA transmitivities vary as much as 6 orders of magnitude.

<u>Resolution</u>: Heterogeneities and modeling are addressed in the *Groundwater Code Selection Technical Memorandum* (Appendix H).

FIELD SAMPLING PLAN

16. Many of the comments made above are applicable to the Field Sampling Plan which restates much of the Work Plan discussion. Therefore, comments made concerning deficiencies in the Work Plan also apply, as appropriate, in the FSP.

    In general, the plan is sloppy with maps showing well locations differently. Further, there is an inadequate evaluation of the existing water table information. Ground water contour maps should have been depicted for each monthly water level change. After all, the purpose of this remedial investigation is to understand the extent of contamination and aquifer characteristics sufficient for designing a remedial action. Given the low density of monitoring well in the area, each new cluster location is critical and should be based on a detailed evaluation of the existing data. Maps should show flowpaths in the vertical sections and incorporate the data from wells like CH-1, CH-2S and -d and TAN-12. Such vertical sections would allow a better understanding of Kv/Kh ratios in determining ground water flowpaths. The available data suggests a very complex ground water flow in the area around the injection well. If the proposed three well clusters are to be sufficient to assess the scope and breadth of the necessary remedial action, all the available water level data should be contoured, vertical flow sections prepared, hydrographs developed and correlated to local environmental conditions, temporal changes in water quality graphed and a water budget for the site determined. Only after such an analysis can the location of well 13 clusters be determined. The scoping session between the Parties during the summer did not have the benefit of a detailed evaluation of existing data and should not serve as the only justification for the number and location of new wells.

    <u>Resolution</u>: Many of the comments presented for the Work Plan are applicable to the FSP and have been addressed as for the Work Plan. For example:

    - Groundwater contour maps (now included in Appendix F).
    - Vertical flow (see Section 2.1.6.6 of the Work Plan).
    - Hydrographs are provided in both Appendix F and H.

17. Table 2-1

    It is unclear as to the results and interpretation from earlier investigations and how the proposed field effort will fit into existing interpretation of contaminant extent and fate and transport.

    <u>Resolution</u>: With expanded discussion of hydrogeologic data, the proposed field effort is now consistent with the identified data gaps.

18. Page 2-10, Section 2.2.2.1

The selection of well cluster locations is not supported by evaluating local conditions. No vertical ground water flow sections have been developed based on the available data. However, the new well cluster locations should be put along possible flowpaths caused by the injection well and lagoon infiltration. The Conceptual Site Model of the relationship of the injection well and the SRPA during injection well was to create a mound which permitted flow in all directions. Given the current treatment of existing data, the only well which makes any sense is TAN 18 and 19. The rationale for selecting well cluster locations is necessary.

Resolution: Well sites have been revised and/or relocated to reflect the current hypothesis (2.1.6.6 of Work Plan) and are now located along potential flowpaths.

19. Figure 3-1

There appears omissions and inaccuracies on this map as compared to others in the Work Plan. USGS-24, for example, has been omitted from the map.

Resolution: The wells planned for sampling are sited on the map (including USGS-24).

WORK PLAN CORRECTIONS/UPDATES IN ADDITION TO THE STATE/EPA COMMENTS

1. The EG&G Idaho Environmental Restoration Program became a department during the review period. The Work Plan has been updated to reflect this change, especially in the area of procedure titles and management structure.

2. The Environmental Impact Analysis has been modified to a Waste Management Plan for the RI/FS only. This change was done to incorporate DOE comments on environmental impacts.

3. A new table was been added to Section 6 of the Work Plan that corrects several inconsistencies in the schedules contained in the Statement of Work.

4. The ARARs have been modified in several areas in accordance with DOE comments. State ARARs on water use and classification that were originally applicable are now relevant and appropriate because they apply to surface waters. Federal ARARs on secondary drinking water standards have been deleted since these standards are not risk-based. Federal ARARs on MCLs and MCLGs have been changed to relevant since the proposed actions are not directly related to drinking water systems. Federal ARARs on siting radioactive waste disposal facilities have been deleted since no new disposal facilities are planned.

Work Plan

Number

EGG-WM-9905

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN AND ADDENDA FOR THE TEST AREA NORTH GROUNDWATER OPERABLE UNIT AT THE IDAHO NATIONAL ENGINEERING LABORATORY

G. J. Stormberg
J. R. Zimmerle

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Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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PREFACE

The Test Area North groundwater system at the Idaho National Engineering Laboratory (INEL) has been identified as an operable unit and is being investigated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA); the Superfund Amendments and Reauthorization Act of 1986; the National Contingency Plan; and applicable Department of Energy (DOE) orders, directives, and policies. To assist in remedial investigation/feasibility study (RI/FS) planning, the following documents have been prepared.

Document Title	Purpose
RI/FS Work Plan (seven sections)	Describes proposed operable unit based on existing knowledge. Identifies data necessary for risk assessment and remedial planning and identifies data quality objectives. Conceptualizes proposed RI/FS data collection activities.
RI Sampling and Analysis Plan (three parts):	
Part I--Field Sampling Plan	Describes in detail proposed field activities to fill data gaps identified in the Work Plan.
Part II--Quality Assurance Project Plan	Describes quality assurance protocols to be implemented in the field and lab during data collection, analysis, and reporting.
Part III--Data Management Plan	Describes proposed activities to store, retrieve, and report RI/FS data and to develop a DOE administrative site record.
Health and Safety Plan	Describes activities to be implemented and protocols to be followed during RI/FS activities to protect the health and safety of RI/FS workers.
Community Relations Plan	Describes INEL activities to be implemented to ensure compliance with public involvement requirements of CERCLA.

Preliminary Identification of ARARs	Presents an initial identification of applicable or relevant and appropriate requirements (ARARs) that may impact RI/FS activities and remedial action.
Proposed Plan for an Interim Action to Reduce the Contamination Near the Injection Well and in the Surrounding Groundwater at the Test Area North Idaho National Engineering Laboratory	Proposed interim action designed to reduce the potential for continued release of contaminants from the Technical Support Facility (TSF-05) injection well.
Waste Management Plan	Presents a detailed evaluation of the treatment and management of remedial investigation generated wastes.

EXECUTIVE SUMMARY

The Idaho National Engineering Laboratory (INEL) was listed on the National Priorities List of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in November 1989. One of the reasons for this listing was the release of contaminants into the groundwater at the INEL's Test Area North (TAN). These contaminants, primarily trichloroethylene (TCE) and related volatile organics, radionuclides such as strontium, and heavy metals such as lead, were released into the groundwater from the Technical Support Facility (TSF) injection well.

In response to this listing, the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the State of Idaho negotiated a Federal Facility Agreement/Consent Order (FFA/CO) and Action Plan. This agreement describes how the DOE, the EPA, and the State of Idaho will implement CERCLA and Resource Conservation and Recovery Act (RCRA) activities at the INEL release sites. At the TAN groundwater release site, the FFA/CO action plan requires the DOE to implement an interim action and a remedial investigation/feasibility study (RI/FS) to characterize the nature and extent of the contamination and to evaluate/ implement possible response actions.

The interim action and the RI/FS [designated as Operable Unit (OU) 1-07A and 1-07B, respectively under the FFA/CO] are parallel, but separate actions with different goals. The primary goals of the interim action are to reduce the levels of contamination in the TSF injection well and in the groundwater near the injection well and to provide field experience and information that could be used in evaluations of remedial action alternatives for the RI/FS. One of the addenda to this document, Proposed Plan for an Interim Action, describes the interim action in more detail. The primary goals and objectives of the RI/FS are to gather data on the other parts of the contaminated aquifer and to evaluate all available data so that the best remedial action for reducing the overall risk from the groundwater can be selected. This Work Plan describes the RI/FS actions in more detail.

This RI/FS Work Plan has been prepared to obtain agreement between the DOE, the EPA, and the State of Idaho on what actions will be needed to meet the goals listed above. This document was developed based on the results of a series of scoping meetings held between the three parties during August 1991.

Specifically, this Work Plan has been designed to:

- Identify a specific and focused scope of work for obtaining necessary and reliable site characterization data for the TAN groundwater system
- Gather sufficient information to adequately and accurately characterize the potential risk from the TAN groundwater
- Identify the key tasks necessary to evaluate and select the best response action for reducing unacceptable risks from the contaminated groundwater
- Integrate FFA/CO requirements into the RI/FS response.

BACKGROUND

In 1987, sampling of the TSF water supply wells confirmed the release of TCE to the groundwater system at TAN. These wells supply drinking and industrial water to TAN, so even though the drinking water has never exceeded the maximum contaminant levels (MCLs) (based on water sampling to date), the detection of TCE above the MCLs represented a risk to TAN personnel. In response to this release, the DOE implemented a Corrective Action Plan to reduce contaminant levels and to protect TAN personnel. Then, in fiscal year (FY) 1989, the DOE started a RCRA Facility Investigation (RFI) to find the source of the release.

Under the RCRA Corrective Action Plan, two actions were taken to reduce the immediate risks from the TAN groundwater release. First, in early 1989, an air sparger was added to the TAN water supply system to remove organics from the water. This air sparger is successfully treating the water to meet drinking water standards as shown by monthly sampling of the TAN water supply. Second, in 1990, an initial remediation effort removed process sludge from the bottom 55 ft of the injection well. This sludge contained high levels of organics and radionuclides, so it is being disposed of as a mixed waste. Since the sludge was removed, some of the other wells at TAN have shown a decrease in contaminant concentrations, but this change will need to be verified in the remedial investigation.

Data gathered under the RFI in FY-89 and FY-90 showed that TCE is the primary contaminant of concern, and that the TSF-05 injection well is the primary source of contamination. Other contaminants have been found, but none of these are as widespread as the TCE. A list of the contaminants of concern can be found in the Work Plan.

The injection well is located in the southwestern corner of the Technical Support Facility at TAN. The well was drilled in 1953 to a depth of 305 ft and has a 12-in. diameter casing with perforations from 180 to 244 ft and from 269 to 305 ft below the land surface. The injection well was used from 1955 to 1972 to dispose of TAN liquid wastes and concentrated evaporator sludges into the fractured basalt of the Snake River Plain Aquifer, which has a water level of about 200 ft at the well. The liquid wastes included organic, inorganic, and low-level radioactive waste waters that were added to non-hazardous process and sanitary waste waters. The concentrated sludges came from an evaporator that processed low-level radioactive wastewaters to reduce waste volume. The sludges were injected into the well from the late 1950s to the early 1960s. Activities that generated these wastes included efforts to develop a nuclear-powered aircraft and tests that simulated accidents involving the loss of coolant from nuclear reactors.

The highest groundwater contamination levels are found near the injection well, but these levels drop off rapidly as distance from the well increases. In the 37 years since the well started operation, the trichloroethylene may have travelled as far as 1-1/2 mi to the southeast of the well. In contrast, the other contaminants of concern have not been found above drinking water standards approximately 3/4 mi from the well for the organics, and 1/4 mi for the metals and radionuclides.

RI/FS Process

Given the amount of information already collected under the RFI, the DOE, the EPA, and the State of Idaho decided to use a "focused" RI/FS to develop the information necessary to select a final remedy for the TAN groundwater system. This focused RI/FS will include a short remedial investigation that will be used to gather data on the vertical distribution of the contaminants and the physical characteristics of the aquifer. The remedial investigation will also be used to verify the probable conditions believed to exist at the site, and to verify or deny any unreasonable deviations from these conditions. A feasibility study will be carried out concurrently with the remedial investigation and will use the new and existing data to evaluate potential remedies. A Proposed Plan will then be prepared for public review that will summarize the RI/FS results and describe the remedy preferred by the DOE, the EPA, and the State of Idaho for cleaning up the TAN groundwater. Public comments will be incorporated into a Record of Decision that will both describe the final remedy and list the criteria used to determine when the remedy has successfully remediated the groundwater.

The first phase of the focused RI/FS involved preparing a conceptual model on the TAN groundwater. This model, which was finalized at the August 1991 scoping meetings, described potential contaminant sources, possible receptors of the contamination, and the pathways between the sources and the receptors. The TSF-05 injection well was identified as the primary source with direct injection into the groundwater as the primary release mechanism. Several other sites were identified as potential, but unlikely, sources including the Initial Engine Test (IET) Facility injection well (IET-06), and the WRRTF injection well (WRRTF-05). Based on existing information, these sites are, at best, minor sources.

The key potential receptors identified in the model were TAN workers and visitors. Current risk is considered to be protective due to treatment of the groundwater before use, although this assumes that the air sparging system remains functional. If the TAN area were returned to public use in the future, farmers or other on-site workers would become potential receptors. The current use scenario for risk calculations is based on no institutional response action (i.e., sparging system). Non-human receptors such as animals and plants were not considered to be significant receptors at this time due to the inaccessibility of the untreated groundwater. The primary pathway identified was through contact (drinking and inhalation of vapors) with the untreated groundwater.

The remedial investigation characterization activities are designed to reach the following goals:

- Confirm that the TSF-05 injection well is the primary source of contamination
- Define both the lateral and vertical extent of organic, metal, and radionuclide contamination for the TAN groundwater system
- Obtain sufficient data of adequate quantity and quality to perform a risk assessment and to evaluate remedial alternatives for the identified contamination sources
- Verify the presence or absence of significant levels of contaminants in or near the IET and WRRTF injection wells
- Determine the estimated risks to human and environmental receptors from the sources of contamination (using current EPA guidance on baseline risk assessments) if no remedial action is taken on the groundwater.

The proposed remedial investigation activities will include several smaller reports (baseline risk assessment, exposure memo, validated sample results) before the final RI report is prepared. These informational reports will be used by the DOE, the EPA, and the State of Idaho to measure technical progress and to gain consensus on technical results in a timely manner.

Feasibility study activities will be occurring simultaneously with RI activities. The goals of the FS are the following:

- Identify and screen potential remedial alternatives based on the data obtained from the RI and the interim action
- Evaluate and select the alternatives that will have the most significant and practical effect on reducing unacceptable risks from the contaminated groundwater.

The final RI/FS report will describe in detail the selection of response actions that will reduce any risks identified in the risk assessment to acceptable levels. This report will be used to prepare the summary Proposed Plan and then the final Record of Decision, which will describe the selected remedial action. The RI/FS report and the summary Proposed Plan will be the key documents for implementing the DOE's policy on integrating CERCLA and environmental impact analyses.

The RI/FS process described in this Work Plan will be completed in 1994. A Record of Decision for the remedial action is anticipated by September 1994.

The Work Plan is accompanied by a number of addenda that provide technical support for the activities proposed during the RI/FS. These addenda include the Field Sampling Plan, the Quality Assurance Project Plan, the Data Management Plan, the Health and Safety Plan, the Community Relations Plan, the Preliminary Identification of Applicable or Relevant and Appropriate Requirements, the Proposed Plan for an Interim Action, and the Waste Management Plan.

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EGG-WM-9905

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR THE TEST AREA NORTH GROUNDWATER OPERABLE UNIT AT THE IDAHO NATIONAL ENGINEERING LABORATORY

G. J. Stormberg
J. R. Zimmerle

May 1992

Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WORK PLAN
FOR THE TEST AREA NORTH GROUNDWATER OPERABLE UNIT
AT THE IDAHO NATIONAL ENGINEERING LABORATORY

May 1992

Reviewers:

Jerry Shea

Jerry Shea, EIRC Chairman, ERD

7/29/92
Date

Jerome R. Zimmerle

Jerome Zimmerle, Manager, TAN WAG 1

7/28/92
Date

Approval:

R. P. Wadkins

Robert P. Wadkins, Unit Manager,
Site Remediation

7/29/92
Date

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FIGURES

TABLES

ACRONYMS

ANL-W	Argonne National Laboratories-West
ANP	Aircraft Nuclear Propulsion Program
ARARs	applicable or relevant and appropriate requirements
ASTM	American Society for Testing and Materials
bls	below land surface
BRA	baseline risk assessment
CDI	chronic daily intake
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CIR	cancer incidence rate
CLP	Contract Laboratory Program
COCA	Consent Order and Compliance Agreement
CRP	Community Relations Plan
CTF	Containment Test Facility
DMP	Data Management Plan
DNAPL	dense nonaqueous phase liquid
DOE	Department of Energy
DOE-ID	Department of Energy, Idaho Field Office
DQO	data quality objective
DWTM	Office of Defense Waste and Transportation Management
ECAO	Environmental Criteria and Assessment Office
EIRC	ERD Independent Review Committee
EIS	Environmental Impact Statement

EPA	Environmental Protection Agency
ERD	Environmental Restoration Department
ESRP	Eastern Snake River Plain
FAST	Full Area Steady State Testing
FFA/CO	Federal Facility Agreement/Consent Order
FR	Federal Register
FS	feasibility study
FSP	Field Sampling Plan
FY	fiscal year
GIN	gas injection north
HHEM	Human Health Evaluation Manual
HRS	Hazard Ranking System
HSP	Health and Safety Plan
HTRE-3	Heat Transfer Reactor Experiment-3
HWRAD	Hazardous Waste Remedial Action Division
ICPP	Idaho Chemical Processing Plant
IET	Initial Engine Test (Facility)
INEL	Idaho National Engineering Laboratory
IWMIS	Industrial Waste Management Information System
LOFT	Loss-of-Fluid Test (Facility)
MOSA	methods of soil analysis
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
OU 1-07	Operable Unit 1-07
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCE	tetrachloroethylene

PMP	Project Management Plan
ppb	parts per billion
ppm	parts per million
PREPP	Process Experimental Pilot Plant
QA/QC	quality assurance/quality control
QAPjP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFDs	reference doses
RFI	RCRA Facility Investigation
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RME	Reasonable maximum exposure
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SARA	Superfund Amendments and Reauthorization Act
SDI	subchronic daily intake
SOP	standard operating procedure
SOW	Statement of Work
SWMU	solid waste management unit
TAN	Test Area North
TCE	trichloroethylene
TRA	Test Reactor Area
TSF	Technical Support Facility
USGS	United States Geological Survey
VOC	volatile organic compound
WAG	waste area group
WBS	Work Breakdown Structure
WRRTF	Water Reactor Research Test Facility

WELL EQUIVALENCY TABLE

TABLE KEY

WELL FUNCTION	FUNCTION DESCRIPTION
Abandoned	Well that has been grouted in
In Use	Actively being used
Monitoring	Well for measuring water levels and chemical concentrations
Not in Use	Well not used but not abandoned
Observation	Well for measuring water levels (groundwater heads)
Piezometer	Short screen observation well
Surface Water Drainage	Overflow for flood control infiltration ponds
USGS Monitoring	USGS well in which water levels are measured, and the USGS obtains chemical concentrations

Equivalent Well Names and Well Usage

INEL WELL NAME	EQUIVALENT NAMES	EASTING (FEET)	NORTHING (FEET)	WELL FUNCTION
ANP-1	ANP1 TAN-1 TAN1 TAN-612	359284.	795781.	PRODUCTION-IN USE
ANP-2	ANP2 TAN-2 TAN2 TAN-613	358805.	796089.	PRODUCTION IN USE
ANP-5	ANP5 BS.OP.1 TAN-ANP-05	343170.	808233.	OBSERVATION
ANP-6	ANP6 WASH-RACK	348248.	801439.	MONITORING
ANP-7	ANP7	347550.	822500.	OBSERVATION
ANP-8	WRRTF-PROD	362700.	789200.	PRODUCTION-IN USE
ANP-9	ANP9 STFA1	368001.	783498.	OBSERVATION
ANP-10	ANP10 STFA2	367750.	784853.	OBSERVATION

Equivalent Well Names and Well Usage (continued)

INEL WELL NAME	EQUIVALENT NAMES	EASTING (FEET)	NORTHING (FEET)	WELL FUNCTION
FET-1	FET1 LOFT-PROD1	353390.	798237.	PRODUCTION-IN USE
FET-2	FET2 LOFT-PROD2	353606.	798112.5	PRODUCTION IN USE
FET-3	FET FET3 FET-DISP LOFT-DISP NRTS FET-DISP#1	352199.	798650.	INJECTION-NOT IN USE
GIN-1	GIN1	360676.	788851.	OBSERVATION
GIN-2	GIN2	361170.	788927.	OBSERVATION
GIN-3	GIN3	361486.	788528.	OBSERVATION
GIN-4	GIN4	361120.	788919.	OBSERVATION
GIN-5	GIN5	361358.	789390.	OBSERVATION
IET-DISP	ANP4 IET TAN/IET IET1 IET-06 IET-INJ	358960.	801550.	INJECTION-NOT IN USE
LOFT-DISP	FET-3 FET3 FET-DISP NRTS FET-DISP#1	352199.	798650.	INJECTION-NOT IN USE
LOFT-PROD1	FET-1 FET1	353390.	798237.	PRODUCTION-IN USE
LOFT-PROD2	FET-2 FET2	353606.	798112.5	PRODUCTION-IN USE
LPTF-DISP	LPTF WRRTF-DISP LPTF1	361869.74	788677.	INJECTION-ABANDONED
NONAM	NONAME TAN-TEST NONAME#1	343698.	794099.	USGS MONITORING

Equivalent Well Names and Well Usage (continued)

INEL WELL NAME	EQUIVALENT NAMES	EASTING (FEET)	NORTHING (FEET)	WELL FUNCTION
OWSLEY-2	OWSLEY2 2ND OWSLEY	376365.	779817.	OBSERVATION
P&B	PARK&BELL	414065.	856409.	OBSERVATION
P&W-1	P&W1	341599.	816099.	OBSERVATION
P&W-2	P&W2	343999.	816400.	USGS MONITORING
P&W-3	P&W3	350801.	818802.	OBSERVATION
PSTF	PSTF TEST	343017.	788224.	USGS MONITORING
TAN-1	ANP-1 TAN1 TAN-612	359284.	795781.	PRODUCTION-IN USE
TAN-2	ANP2 TAN2 TAN-613	358805.	796089.	PRODUCTION-IN USE
TAN-3	TAN3	359063.	796508.	MONITORING
TAN-4	TAN4	358378.	795682.	MONITORING
TAN-5	TAN5	358353.	795647.	MONITORING
TAN-6	TAN6	361775.	793961.	MONITORING
TAN-7	TAN7	361771.	793914.	MONITORING
TAN-8	TAN8	358067.	793501.	MONITORING
TAN-9	TAN9	356987.	795490.	MONITORING
TAN-10	TAN10	356953.	795192.	MONITORING
TAN-10A	TAN10A	356923.	795238.	MONITORING
TAN-11	TAN11	356931.	795159.	MONITORING
TAN-12	TAN12	356907.	795121.	MONITORING
TAN-13	TAN13	356565.	794093.	ABANDONED
TAN-13A	TAN13A	356527.	794110.	MONITORING
TAN-14	TAN14	356552.	794052.	MONITORING
TAN-15	TAN15	361715.	792165.	MONITORING
TAN-16	TAN16	361716.	792120.	MONITORING
TAN-17	TAN17	358112.	793496.	MONITORING
TAN-TEST	NONAM NONAME NONAME#1	343698.	794099.	OBSERVATION

Equivalent Well Names and Well Usage (continued)

INEL WELL NAME	EQUIVALENT NAMES	EASTING (FEET)	NORTHING (FEET)	WELL FUNCTION
TCH-1	TCH1 TAN-CH1	356797.	795929.	COREHOLE-PIEZOMETER
TCH-2S	TCH2S TAN-CH2S	358051.	793456.	COREHOLE-PIEZOMETER
TCH-2D	TCH2D TAN-CH2D	358051.	793456.	COREHOLE-PIEZOMETER
TAN-D1	TD-1 TAN-DD2 TD1 TAN-DISP1	358627.	794343.	SURFACE WATER DRAINAGE
TAN-D2	TD-2 TAN-DD2 TD2 TAN-DISP2	356956.	795507.	SURFACE WATER DRAINAGE
TAN-D3	TD-3 TAN-DD3 TD3 TAN-DISP3	354968.	797824.	SURFACE WATER DRAINAGE
TSF-DISP	ANP-3 TSFINJ TSF-INJ TSF-05 TAN-330 TSF A&M3 TAN A&M3	356999.	795400.	INJECTION-NOT IN USE
TSF-INJ	ANP-3 TSFINJ TSF-DISP TSF-05 TAN-330 TSF A&M3 TAN A&M3	356999.	795400.	INJECTION-NOT IN USE
USGS-7	USGS7	347516.	785566.	USGS MONITORING
USGS-24	USGS24	358398.	795214.	MONITORING
USGS-25	USGS25	347252.	812275.	OBSERVATION
USGS-26	USGS26	369610.	803470.	MONITORING
WRRTF-PROD	ANP-8	362700.	789200.	PRODUCTION-IN USE
WRRTF-DISP	LPTF-DISP	362700.	789200.	ABANDONED

1. Introduction

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1. INTRODUCTION

1.1 Work Plan Scope

The objectives of the remedial investigation/feasibility study (RI/FS) for the Test Area North (TAN) Groundwater Operable Unit 1-07B at the Idaho National Engineering Laboratory (INEL) are to determine the nature and extent of groundwater contamination, and to develop and evaluate options for a remedial action. During scoping meetings between the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the State of Idaho, volatile organics (e.g., trichloroethylene and related organics) were identified as the major contaminants of concern. Other contaminants (e.g., lead and strontium-90) have also been identified in the groundwater system at concentrations of concern, but are not as widely distributed as the volatile organics. This Work Plan was prepared for the purposes of:

- Documenting the RI/FS process
- Describing the TAN Groundwater Operable Unit using existing information
- Identifying additional data needed to make decisions required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
- Identifying site investigations and feasibility studies needed to obtain the additional data.

The Work Plan is organized into seven sections:

1. Introduction--gives the scope of the Work Plan and addenda, and reviews the regulatory history of the TAN Groundwater Operable Unit.
2. Site Background--describes operable unit characteristics based on existing information.
3. Initial Evaluation--contains an operable unit conceptual model that identifies potential contaminant sources, pathways, and receptors.
4. Work Plan Rationale--identifies RI/FS approach and data quality objectives for proposed remedial investigation activities.
5. RI/FS Tasks--describes projects identified for the RI/FS.

6. Schedule--includes a schedule for RI/FS activities in accordance with the RI/FS Scope of Work.

7. References--lists references cited in the above sections.

Documents (addenda) prepared and included with the Work Plan are as follows:

- Sampling and Analysis Plan--is comprised of a Field Sampling Plan, which describes proposed field activities; a Quality Assurance (QA) Project Plan, which describes anticipated QA activities; and a Data Management Plan, which describes policies, procedures, and activities to guide data generation use, and to address preparation of an RI/FS Administrative Record for the DOE.

- Health and Safety Plan--describes policies and procedures to protect RI/FS workers during the study.

- Community Relations Plan--describes policies, procedures, and activities DOE will use to involve the public in the decision-making process concerning TAN Groundwater RI/FS remedial activities.

- Preliminary Identification of Applicable, Relevant, and Appropriate Requirements (ARARs)--requirements that may impact RI/FS activities and remedial action.

- Proposed Plan for an Interim Action to Reduce the Contamination Near the Injection Well and in the Groundwater at Test Area North--describes a proposed plan of activities to reduce the potential for continued contaminant release to TAN groundwater.

- Waste Management Plan--provides information on how the wastes from the interim action and the RI/FS will be management.

The DOE (which manages the INEL), the EPA, and the State of Idaho initiated the RI/FS pursuant to CERCLA, Section 120. The RI/FS process (Figure 1-1) will be supplemented as needed to meet DOE policy requirements for assessment of environmental impacts. The final product of this study will be a single, integrated set of documents, which includes a Remedial Investigation Report, a feasibility study, and an assessment of environmental impacts that satisfies environmental impact requirements in accordance with DOE policy.

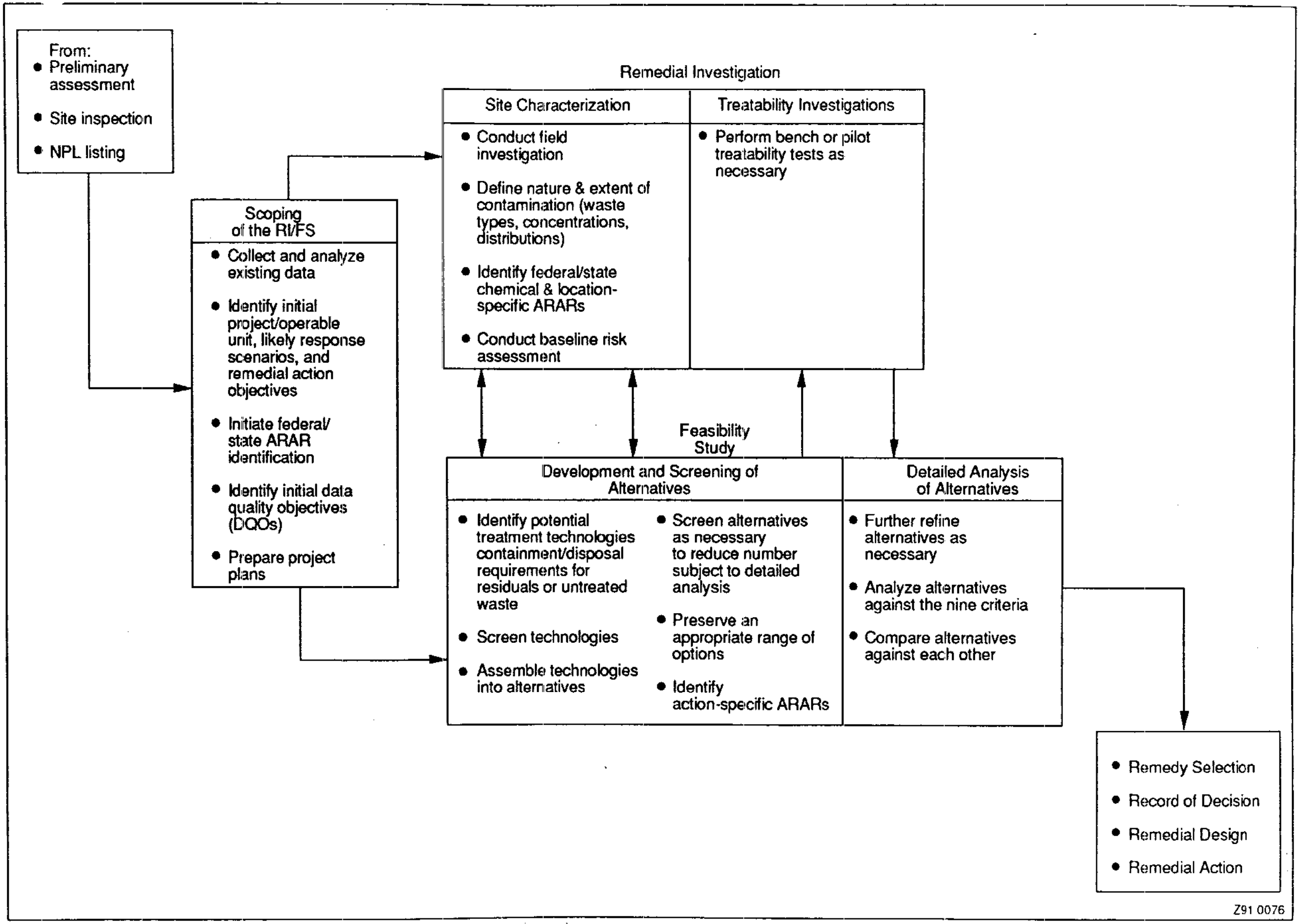


Figure 1-1. RI/FS process (EPA, 1988b).

1.2 TAN Operable Unit Regulatory History

EPA proposed listing the INEL on the National Priorities List (NPL) of the National Contingency Plan (NCP) July 14, 1989 (54 FR 29820). This was done using Hazard Ranking System procedures found in the NCP.

As a federal facility, the INEL is eligible for the NPL pursuant to the NCP by Code of Federal Regulations (CFR) 40 CFR 300.66(c)(2). Several special provisions apply to NPL federal facilities, including a restriction on expenditure of CERCLA monies [CERCLA 111(e)(3)]. Three mechanisms exist for placing sites on the NPL. The principal of these is application of the Hazard Ranking System (HRS), which is a model that evaluates relative potential of uncontrolled hazardous substances to cause human health/safety or ecological/environmental damage. This system scores the relative potential on a scale of 0 to 100. Sites scoring 28.50 or greater are eligible for the NPL. The INEL's score was 51.91. The other two mechanisms for placing a site on the NPL are (a) the site is nominated by a state as its top priority site, or (b) the site has specific characteristics as listed in 40 CFR 300.66(b)(4). Data that support listing the INEL as an NPL site are found in the Federal Facilities Docket, EPA Headquarters, Washington, D.C.

After considering public input during a 60-day comment period following the proposed INEL listing, EPA issued a final rule listing the INEL Site. The rule was published in the Federal Register, November 21, 1989.

The initial remediation of the TAN groundwater system occurred under the corrective action procedures of RCRA Subtitle C, but was then placed into the RI/FS process outlined in the NCP as promulgated by EPA under CERCLA/SARA authority (54 FR 29820). The TAN injection well and associated groundwater system was one of three release sites in the Consent Order and Compliance Agreement (COCA) (EPA, 1987a) identified for remedial action under RCRA. The groundwater was being addressed through RCRA regulations as a release site, and a Corrective Action Plan was prepared under COCA provisions. Subsequent to listing the INEL on the NPL and with the development of a Federal Facility Agreement/Consent Order (FFA/CO) (effective date December 9, 1991), the DOE, the EPA, and the State of Idaho have decided that the TAN groundwater system should be remediated through the CERCLA-driven RI/FS process. The FFA/CO establishes the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the Site in accordance with CERCLA, RCRA, and the Idaho Hazardous Waste Management Act. At the TAN groundwater release site, the FFA/CO requires the implementation of an interim action (OU 1-07A) and an RI/FS (OU 1-07B) to determine appropriate response actions for reducing the risk from the contaminant release into the groundwater. Information gathered as part of the interim action will be incorporated into the TAN groundwater RI/FS report.

2. Site Background

Number

2. SITE BACKGROUND

The Idaho National Engineering Laboratory (INEL) is located 42 mi west of Idaho Falls, Idaho, and occupies 890 mi^2 of the northwestern portion of the Eastern Snake River Plain (Figure 2-1). The INEL is bound on the northwest by three major mountain ranges: Lost River, Lemhi, and Beaverhead (Figure 2-2). The remainder of the INEL is bound by parts of the Eastern Snake River Plain (Bowman et al., 1984).

The INEL was established in 1949 by the U.S. Atomic Energy Commission to build, operate, and test various nuclear reactors, fuel processing plants, and support facilities. To date, 52 reactors have been constructed; 13 are still operable. Today, the INEL also supports other government-sponsored projects including energy, defense, environmental, and ecological research.

The Test Area North (TAN) complex is the northern-most facility within the INEL (Figure 2-2) and consists of several experimental and support facilities for conducting research and development activities on reactor performance. The major facilities at TAN include the Technical Support Facility (TSF), the Containment Test Facility (CTF), the Loss-of-Fluid Test Facility (LOFT), the Specific Manufacturing Capability (SMC), the Water Reactor Research Test Facility (WRRTF), and the Initial Engine Test (IET) Facility (Figure 2-3).

TAN is located approximately 50 mi northwest of Idaho Falls, Idaho and 15 mi west of Terreton, Idaho (Figure 2-2). The main entrance to TAN is located in Butte County, Section 13, Township 6 North, Range 31, east of the United States Geological Survey (USGS) Circular Butte Quadrangle. The entire complex encompasses portions of both Butte and Jefferson counties.

2.1 SITE ENVIRONMENTAL CONDITIONS

2.1.1 Surface Features

The sagebrush-covered land surface of the INEL is relatively flat. The predominant relief in the area is from volcanic vents (buttes) and unevenly

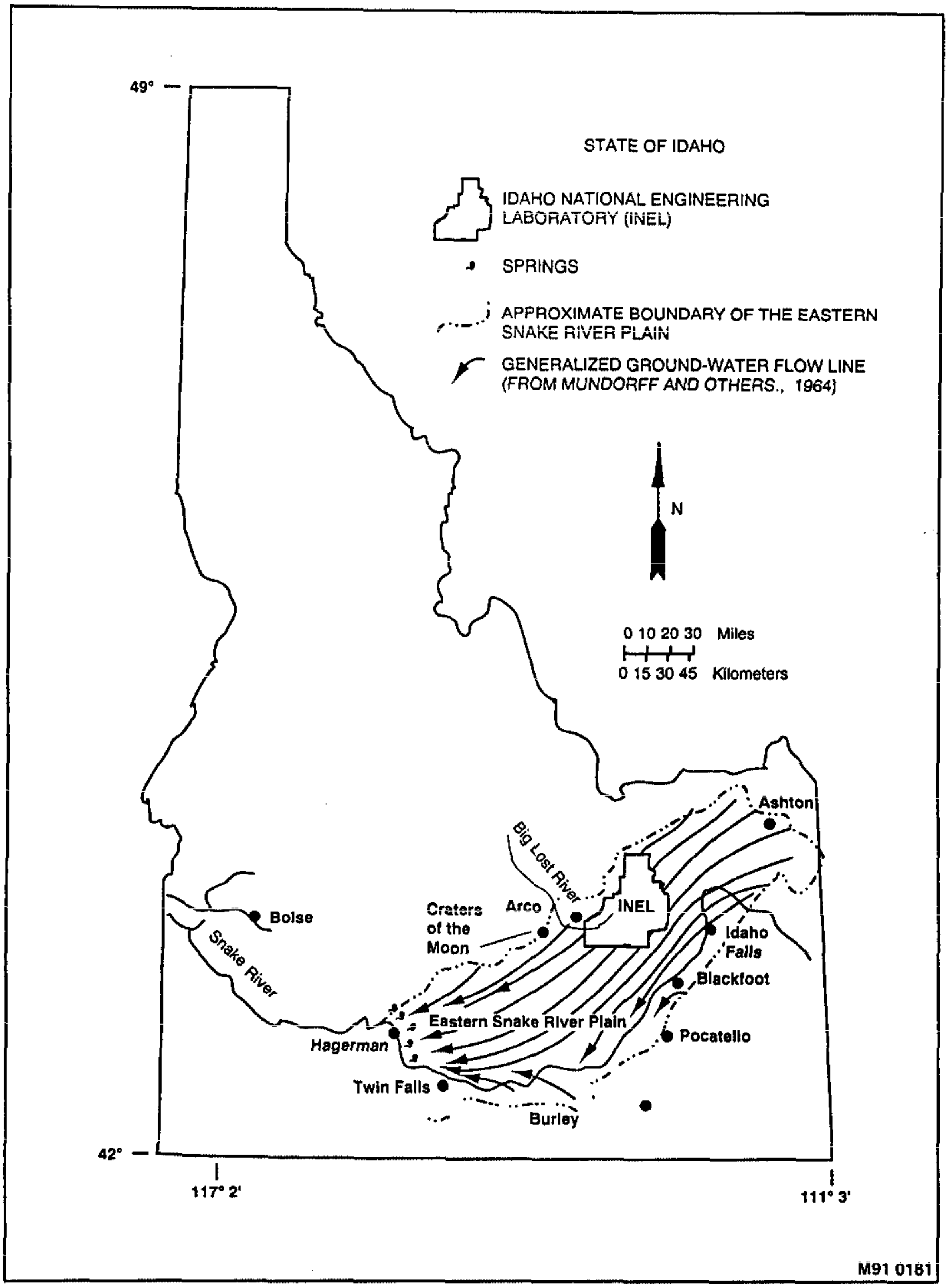
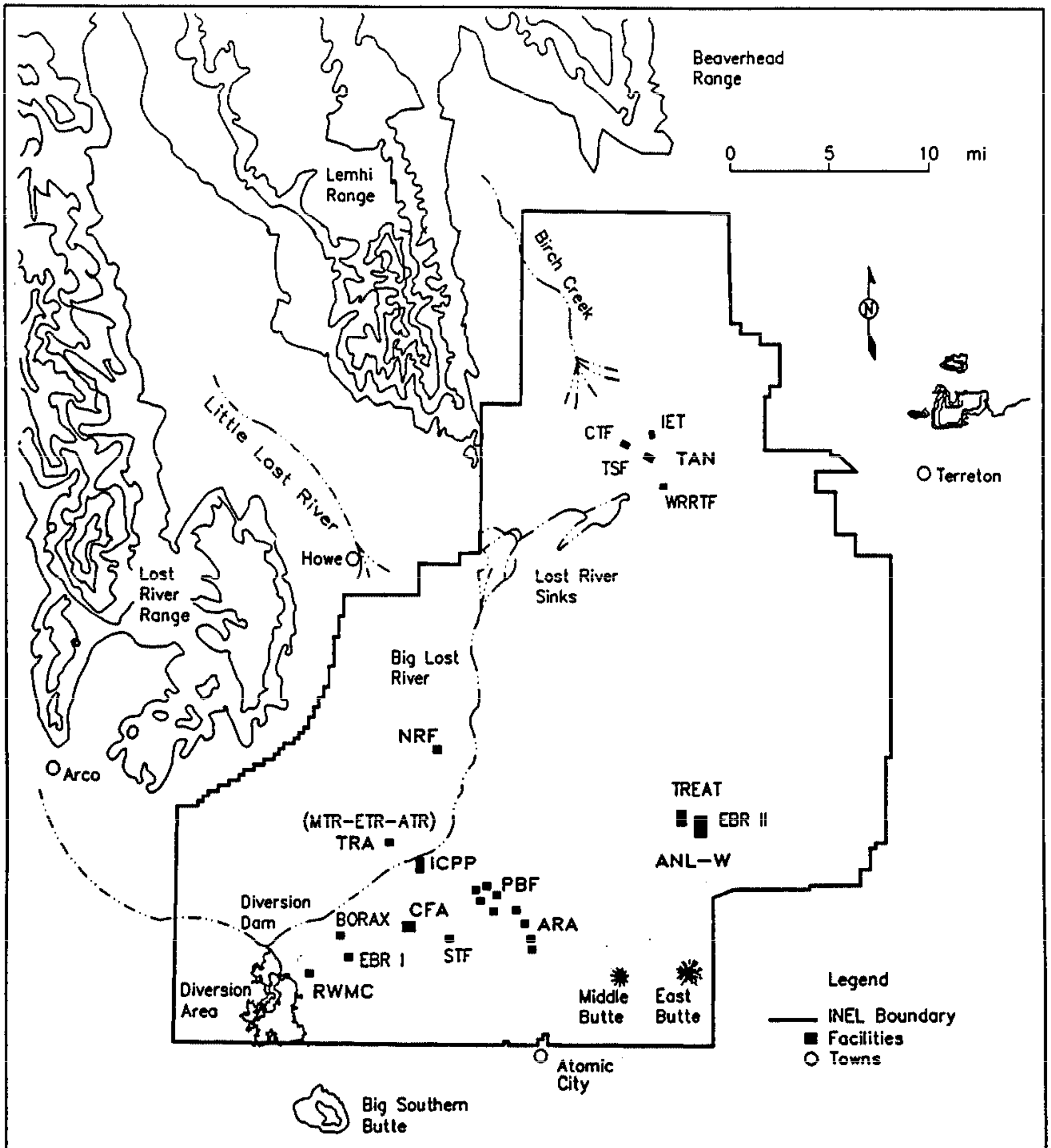


Figure 2-1. Map of Idaho showing the location of the INEL, Snake River Plain, and generalized groundwater flow lines of the Snake River Plain Aquifer (Hull 1989).



ATR	Advanced Test Reactor	MTR	Materials Testing Reactor
ARA	Auxiliary Reactor Area	NRF	Naval Reactor Facility
ANL-W	Argonne National Laboratory-West	PBF	Power Burst Facility
CFA	Central Facilities Area	RWMC	Radioactive Waste Management Complex
CTF	Contained Test Facility	STF	Security Training Facility
ETR	Engineering Test Reactor	TAN	Test Area North
EBR-I	Experimental Breeder Reactor I	TRA	Test Reactor Area
EBR-II	Experimental Breeder Reactor II	TREAT	Transient Reactor Test (Facility)
ICPP	Idaho Chemical Processing Plant	TSF	Technical Support Facility
IET	Initial Engine Test	WRRTF	Water Reactor Research Test Facility

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Figure 2-2. Map of the INEL and surrounding area.

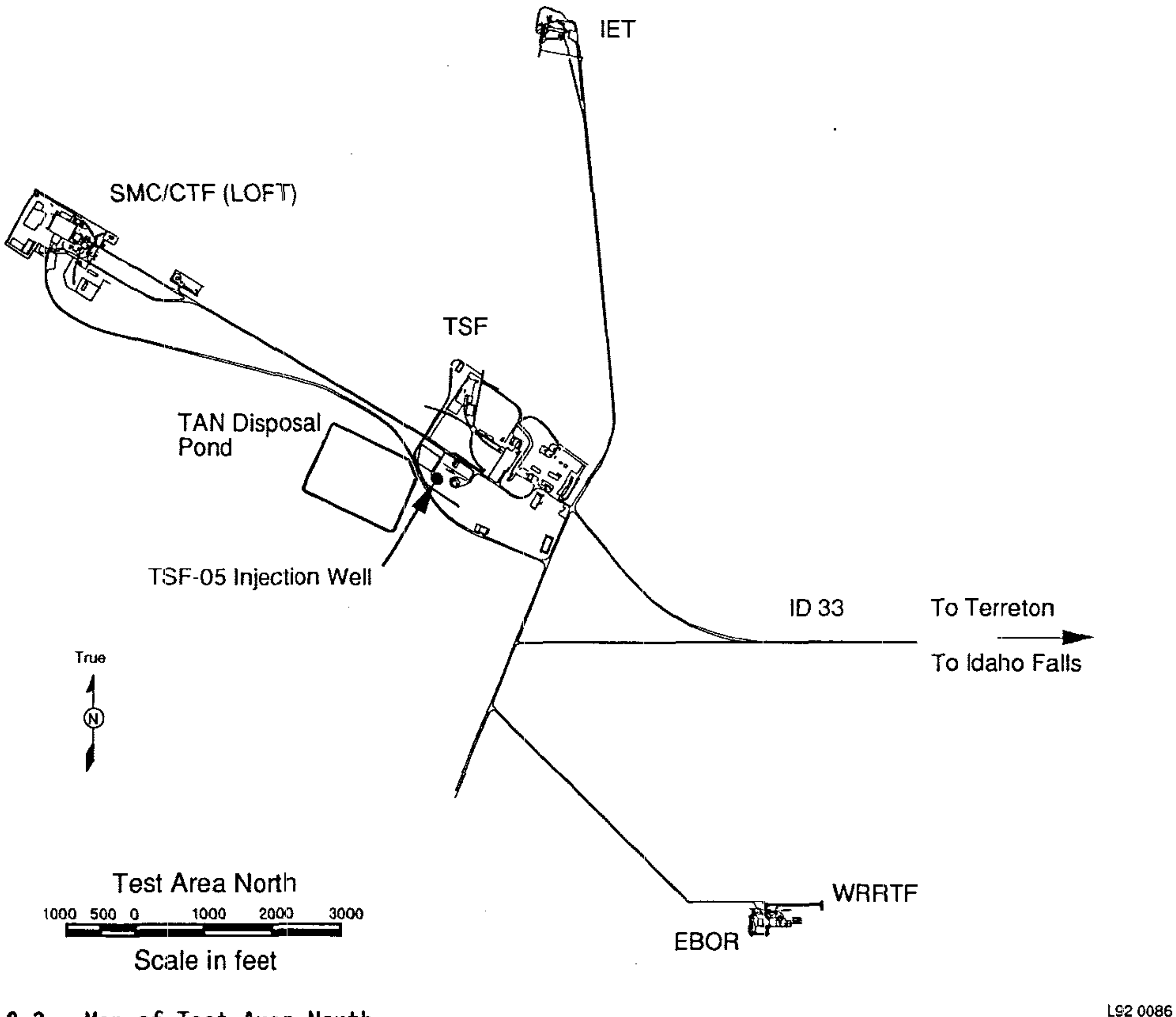

Figure 2-3. Map of Test Area North.

surfaced and fissured basalt lava flows. Elevations on the INEL range from 5,200 ft in the northeast to 4,750 ft in the southwest, with the average being 5,000 ft (Bowman et al., 1984). A broad ridge extends from the southwest to the northeast through the Big Southern, Middle, and East Buttes on the southern portion of the INEL. This ridge effectively separates drainage from the mountains to the northwest from that of the Snake River. TAN lies in a topographic depression between the base of the Lemhi Range to the northwest, the Beaverhead Mountains to the northeast, and the Snake River drainage to the southeast. The surface is relatively flat, with the elevation in this area ranging from a low of 4,774 ft on the Birch Creek playa floor to a high of 5,064 ft on top of Circular Butte.

In western and northern portions of the INEL, the Big Lost River, the Little Lost River, and Birch Creek have created a flood plain consisting of gravel and sand carried from the local mountain ranges. The rivers drain into a series of playa lakes that recharge portions of the Snake River Plain Aquifer.

2.1.2 Meteorology

A Weather Bureau station was established on the INEL (then the National Reactor Testing Station) in 1949. A full range of hourly and daily climatological observations are made by the Weather Bureau staff. There are 27 meteorological observation stations in operation at and surrounding the INEL. Wind speed and direction are measured at all stations. Three stations are "primary" observation stations and include tall towers equipped to measure wind and air temperature at multiple levels (up to 250 ft). Atmospheric humidity is recorded at the Central Facilities Area (CFA) and Argonne National Laboratory-West (ANL-W), and air temperature at the 5-ft level and precipitation are recorded at CFA.

Based on National Oceanic and Atmospheric Administration (NOAA) records from 1950 to 1988, the INEL receives an average annual precipitation of 221 mm, with about 30% of the precipitation falling as snow (Clawson et al., 1989). The average annual precipitation at TAN for the period April 1950 through December 1963 was 198 mm (Bowman et al., 1984). Average temperature extremes at TAN from 1950 through 1963 ranged from 33.8°C (92.8°F) in July to

-25.4°C (13.7°F) in January. Average wind speed at the 20-ft level at TAN ranged from 4.6 mph in December and January to 9 mph in April, May, and June for the period of 1950 through 1964. Wind speeds at the 150 ft level were 3 to 4 mph greater than for the 20 ft level.

The reader is referred to the following documents for detailed discussions of meteorological parameters and climatological statistics for the INEL in general and TAN specifically: NOAA, 1983; NOAA, 1984; and Clawson et al., 1989.

2.1.3 Regional Surface Drainage

Most of the INEL is located in the Pioneer Basin, a poorly defined closed drainage basin (Figure 2-4). Surface water within the Pioneer Basin includes that from the Big Lost River, the Little Lost River, and Birch Creek, all of which drain mountain watersheds located to the north and northwest of the INEL (Barraclough et al., 1981). Local rainfall and snowmelt contribute to surface water, mainly during spring months. Most of the flow from the Little Lost River and Birch Creek is diverted for irrigation purposes before reaching the INEL. However, in very high flow years, Birch Creek flows into the Birch Creek Playa (Playa 4 on Figure 2-5) on the north end of the INEL and infiltrates into the subsurface. The Little Lost River flows onsite during high flow years and infiltrates into the soil.

The Big Lost River (Figure 2-6), the major surface water feature on the INEL, flows southeastward through the Big Lost River Basin past Arco to the Eastern Snake River Plain (ESRP). The river flows onto the INEL near the southwest boundary of the site, curves to the northeast, and flows northward to the Big Lost River Playas. The playa area covers several hundred acres and consists of fluvial and lacustrine sediments (Bowman et al., 1984). In high-flow years, the Big Lost River may overflow its own playas and enter the Birch Creek Playa. Storage and diversion systems on the Big Lost River include Mackay Dam, 30 mi (48 km) upstream of Arco, several irrigation diversions between Mackay and the ESRP, and the INEL flood diversion dam (Bennett, 1990).

The annual discharge of the Big Lost River measured below the Mackay Reservoir is shown in Figure 2-7. Streamflow below Mackay Reservoir exceeded

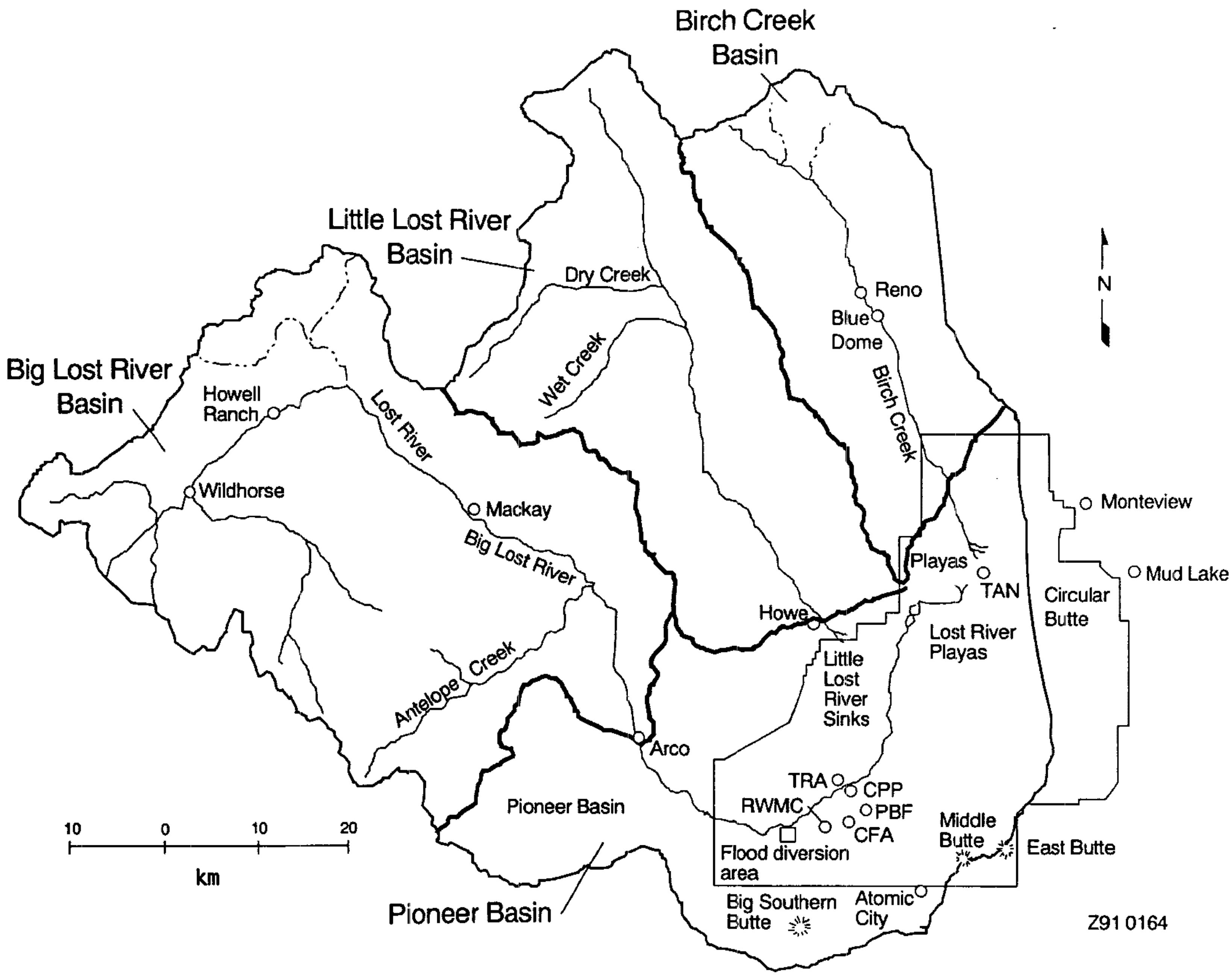

Figure 2-4. Drainage basins affecting the INEL.

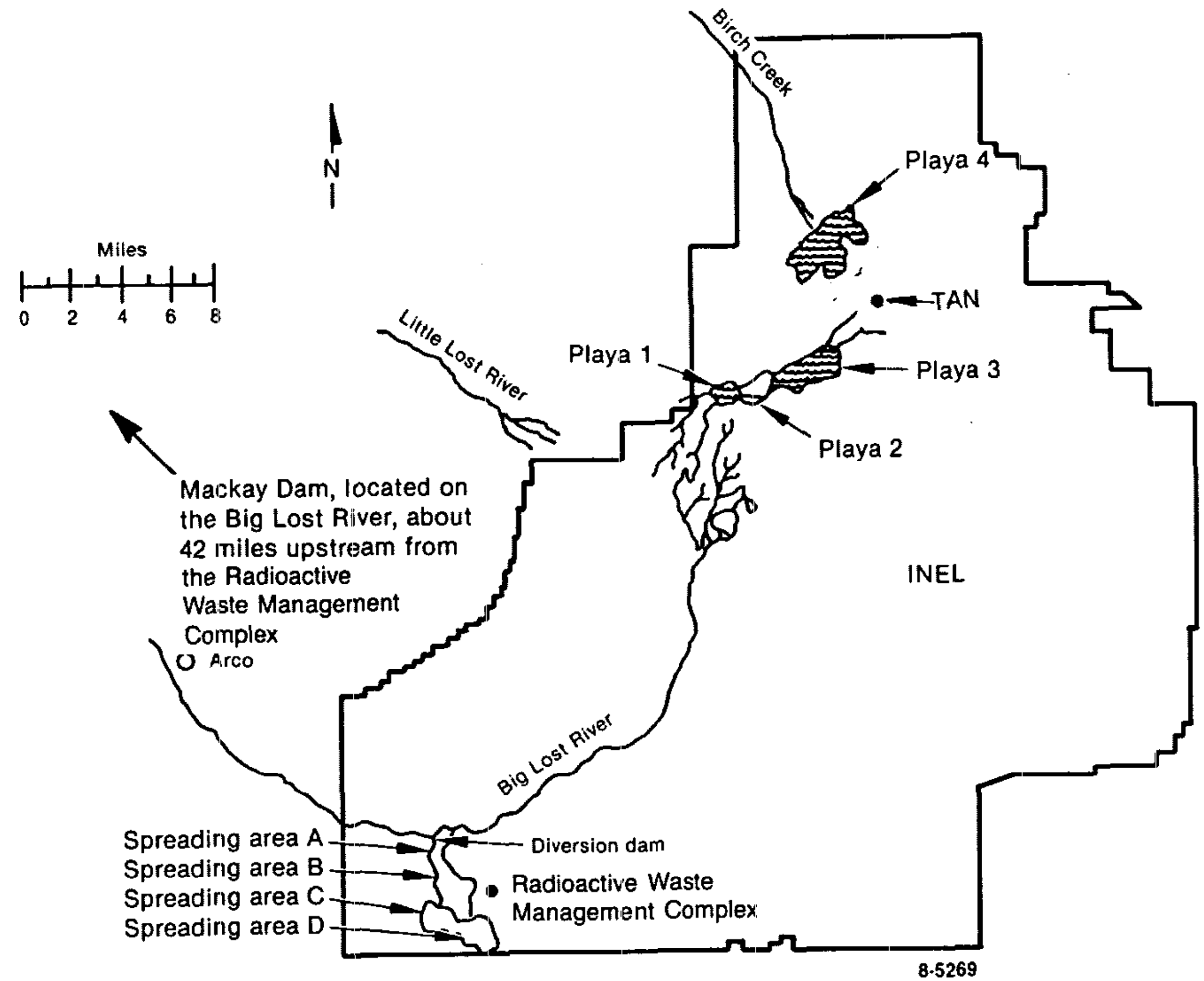

Figure 2-5. Surface water features at or near the INEL (Bowman et al., 1984).

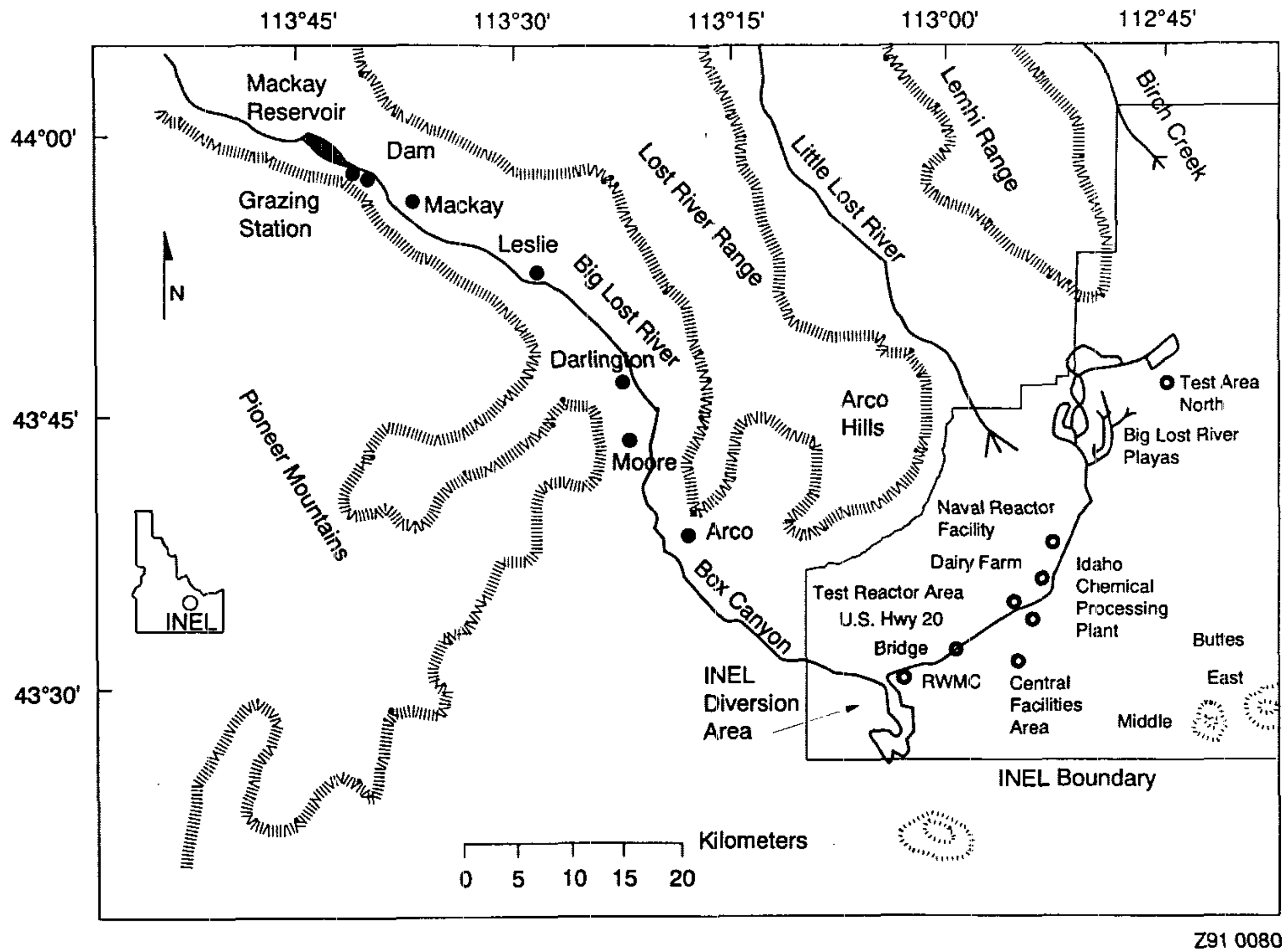

Figure 2-6. Sites along the Big Lost River downstream from Mackay Reservoir.

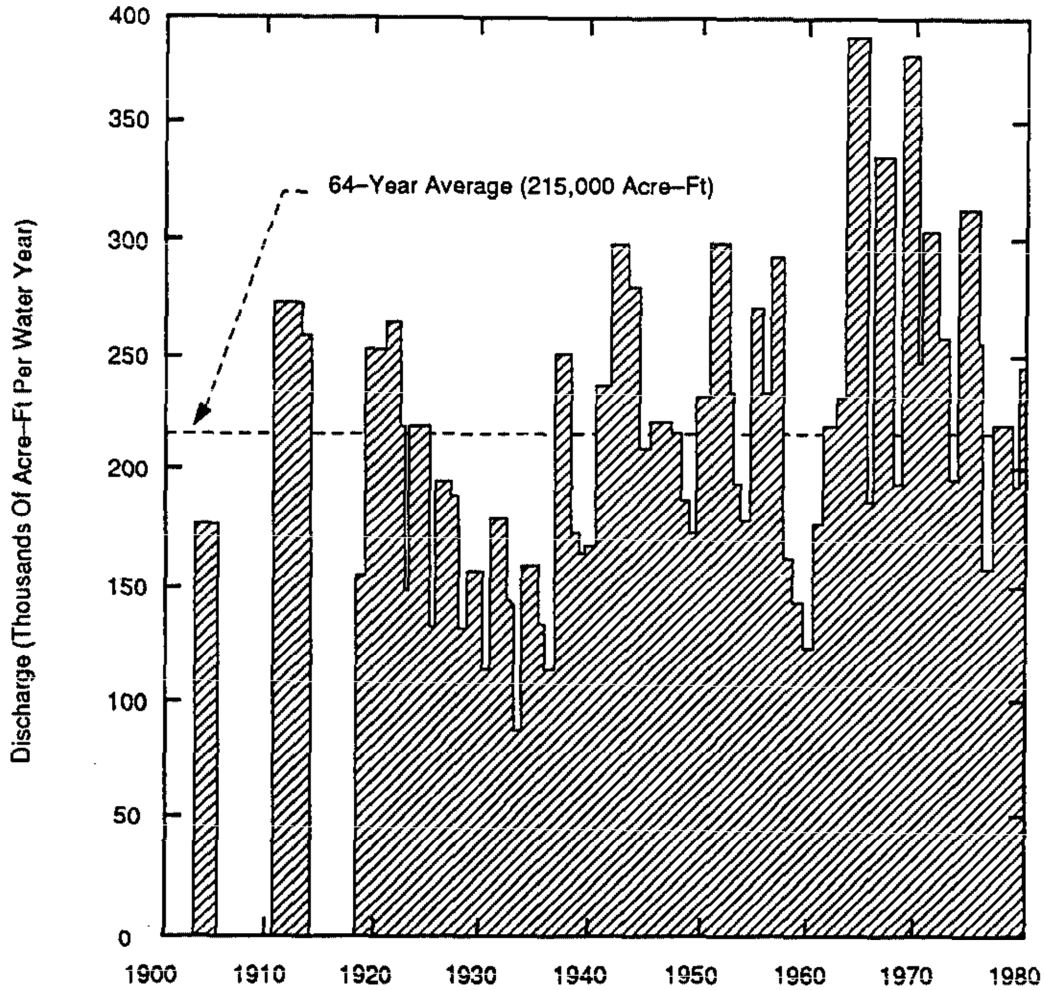

Figure 2-7. Annual discharge for the Big Lost River below Mackay Reservoir near Mackay, 1904-87 (Bowman et al., 1984).

400,000 acre ft/yr in 1965, 1983, and 1984. The annual discharge of the Big Lost River below the INEL diversion channel is shown in Figure 2-8, and the average annual discharges for the Big Lost River, the Little Lost River, and Birch Creek are given in Table 2-1. The average annual discharge for the period of record for the Big Lost River is 2.28×10^5 acre ft/yr (Bennett, 1990). Water quality data for the Big Lost River show that the water is a calcium bicarbonate-type with small amounts of magnesium and sulfate (see Tables 2-2 and 2-3).

2.1.4 Geology of the INEL

The INEL is located on the northern edge of the ESRP, a 54-mi-wide northeast-trending basin extending from the vicinity of Twin Falls on the southwest to Yellowstone National Park on the northeast (Figures 2-9 and 2-10). The ESRP truncates basin and range structures on the northwest and southeast with 3,960 to 4,620 ft of relief between the ranges and the relatively flat plain (Leeman, 1982).

The basin and range structures either terminate at the margin of the plain or extend only a few miles into it (Mabey, 1982). Compared with the Western Snake River Plain (Figure 2-9), the ESRP has not subsided greatly and is actually rising near its eastern tip. The ESRP contains a substantial volume of silicic and basaltic volcanic rocks with relatively minor sediment, except along its margins, where drainages emerge from the neighboring highlands (Leeman, 1982). The basalts have displaced the Snake River (Figure 2-10) southward to its present course (Walker, 1964).

The mountain ranges north of the plain, the Lemhi, Beaverhead, and Lost River (Figure 2-10), are composed of Paleozoic sedimentary rocks that were folded and faulted along the northeastward-trending axis during late Cretaceous or early Tertiary Laramide Orogeny. Many of these Paleozoic rocks dip toward the axis of the plain (Nace et al., 1975). Within the margins of the plain, Miocene and younger volcanic rocks rest unconformably upon the deformed or tilted sedimentary and plutonic rocks ranging in age from Precambrian to Mesozoic and upon faulted remnants of middle to late Eocene "calcalkalic" volcanic rocks (Leeman, 1982).

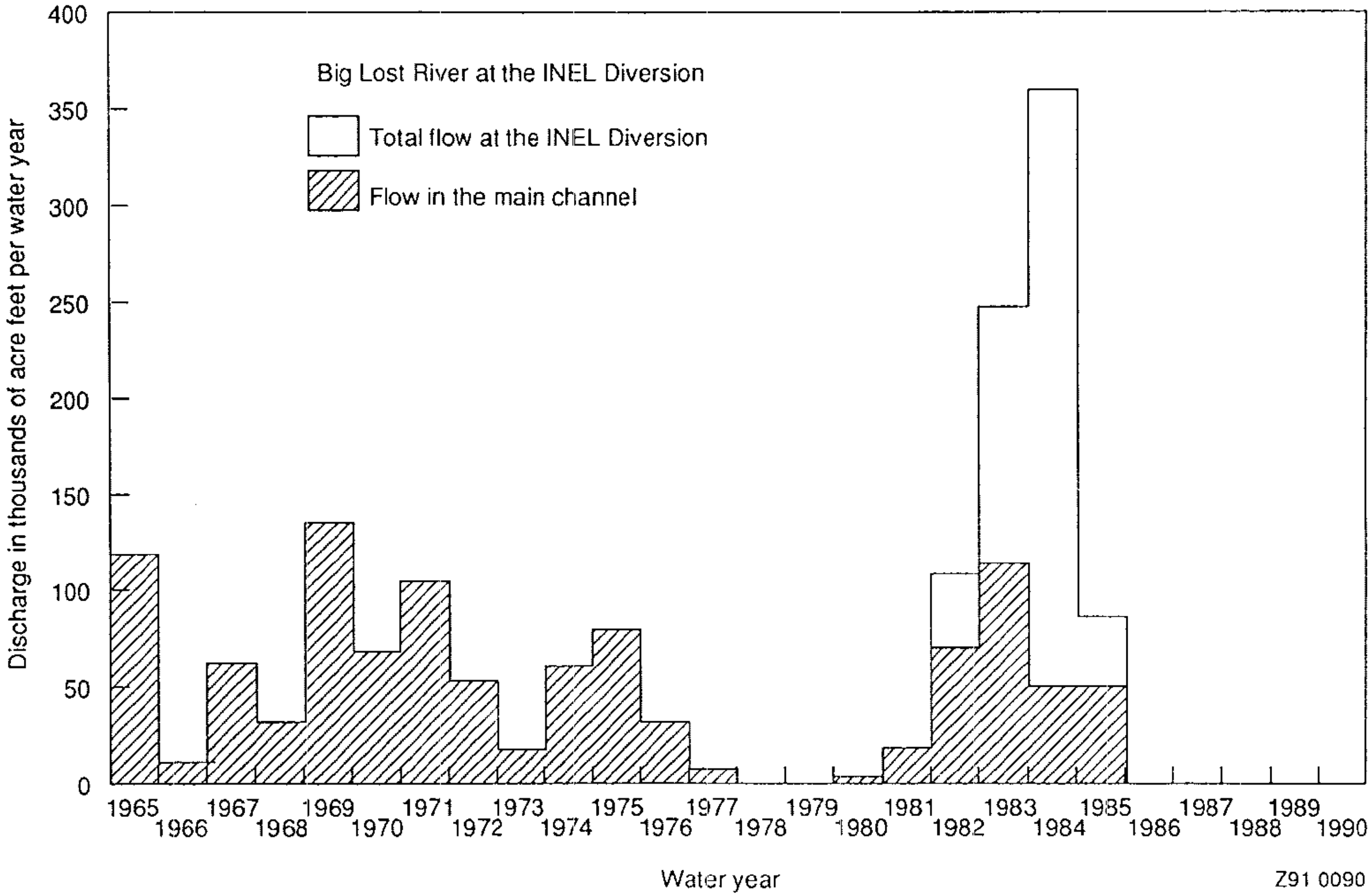

Figure 2-8. Discharge of the Big Lost River at the INEL diversion channel (Pittman et al. 1988).

Table 2-1. Average discharge of streams near the INEL

Drainage System	Discharge (acre-ft/yr)	Discharge (m^3/yr)
Birch Creek[a]	5.7×10^4	7.0×10^7
Little Lost River[b]	5.0×10^4	6.0×10^7
Big Lost River[c]	2.28×10^5	2.8×10^8

a. Measured near Reno, Idaho (Bowman et al., 1984).

b. Measured about 7 mi northwest of Howe, Idaho (Bowman et al., 1984).

c. Measured below Mackay Dam 30 mi northwest of Arco, Idaho (Bennett, 1990).

Table 2-2. Chemistry of a water sample from the Big Lost River, collected near Butte City, Idaho, December 7, 1977[a]

Chemical Characteristics	Big Lost River Water Sample[b] (mg/L)
Calcium (Ca^{2+})	61.0
Magnesium (Mg^{2+})	18.0
Potassium (K^{+})	1.7
Sodium (Na^{+})	11.0
Hydrogen carbonate (HCO_3)	260.0
Carbonate ion (CO_3^{2-})	0.0
Chloride (Cl^{-})	8.2
Fluoride (F^{-})	0.3
Hydroxide (OH^{-})	0.0
Sulfate (SO_4^{2-})	23.0
Silicon dioxide (SiO_2)	15.0
Concentration of hydrogen ions (pH)	6.4
Specific conductance	420.0[c]

a. Bowman et al., 1984.

b. Analyzed at the U.S. Geological Survey Central Laboratory, Denver, Colorado.

c. In microsiemen per centimeter at 20°C.

Table 2-3. Water chemical parameters for the Big Lost River during the 1975 spring and autumn seasons at upper and lower sample areas[a]

Chemical Parameter[b]	Spring Upper[c]	Spring Lower[d]	Autumn Upper[c]	Autumn Lower[d]
Turbidity (Jackson turbidity units)	27.00	72.00	34.00	63.00
Total solids	287.00	480.00	254.00	258.00
Nitrate	0.45	0.58	1.33	0.55
Ortho phosphate	0.10	0.32	0.02	0.01
Hardness ($CaCO_3$)	144.00	160.00	158.00	150.00
Calcium	42.00	45.00	41.00	34.00
Sulphate	25.00	21.00	15.20	17.00
Fluoride	0.15	0.15	0.10	0.10
Specific conductivity (mhos/cm)	280.00	305.00	330.00	310.00
Alkalinity	140.00	152.00	164.00	152.00
Iron	0.19	0.43	0.05	0.48
Manganese	50.00	230.00	10.00	20.00
Sodium	5.80	6.60	4.20	5.10
Potassium	1.50	1.50	0.80	1.00
Chloride	4.00	4.00	2.00	2.00
Suspended solids	112.00	312.00	89.00	120.00
T. Kjeldahl	1.70	1.80	1.40	1.20
T. Inorganic Phosphate	0.52	0.37	0.08	0.02
T. Phosphorus	0.18	0.11	0.03	0.07

a. Bowman et al., 1984.

b. Units are ppm unless stated.

c. Upper sample area above Arco.

d. Lower sample area on INEL site.

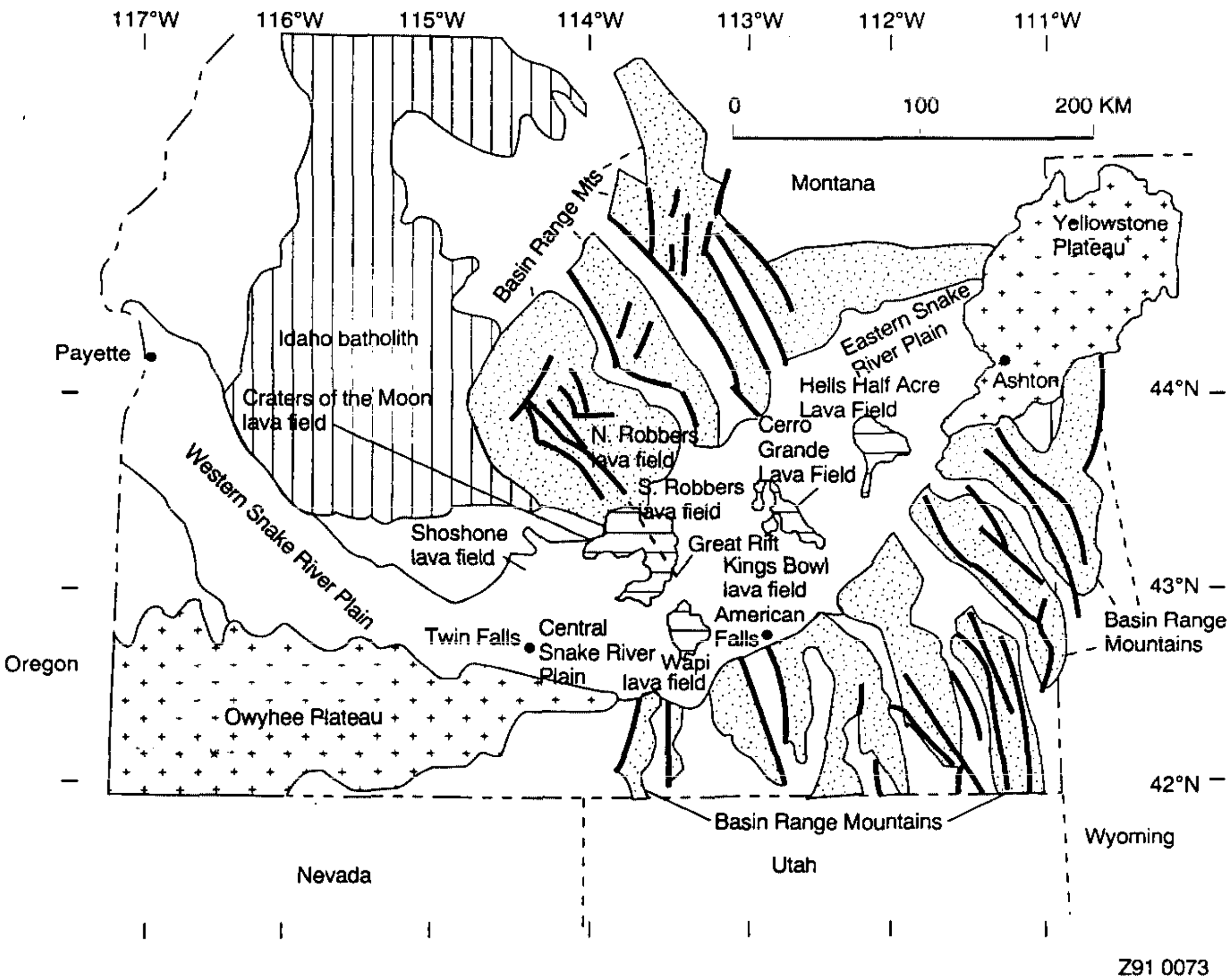

Figure 2-9. Generalized map of southern Idaho showing major geologic and physiographic features and locations (Kuntz et al., 1982).

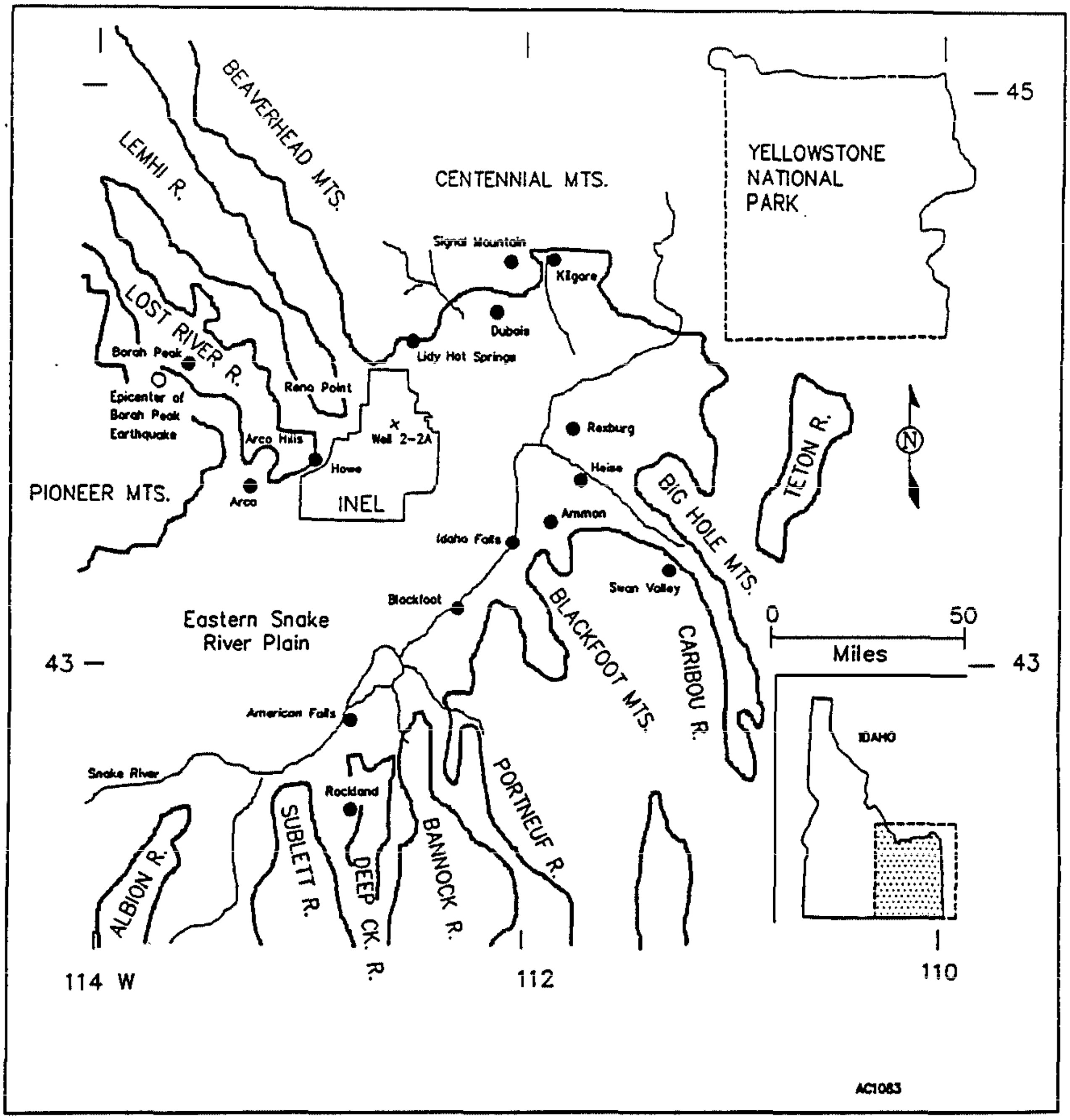

Figure 2-10. Index map of the Eastern Snake River Plain in southeast Idaho (Leeman, 1982).

The current theory of the evolution of the ESRP is that the continental crust passed over a rooted hot spot that is at least several hundred miles below the surface, and this hot spot is currently under Yellowstone National Park (Leeman, 1982). Passage over this hot spot caused the formation of several calderas that become progressively younger to the northeast (Figure 2-11). Beneath the INEL, the calderas are 5.5 to 6.5 million years old and are covered by 0.6 to 1.2 mi of younger basalt flows (Hackett et al., 1986). Hackett (1986) estimates that basalt magma was formed beneath the ESRP by the melting of the earth's upper mantle at a depth of approximately 31 to 37 mi. Based upon potassium-argon dating, the rate of movement over the hot spot is approximately 1.4 in./yr (Embree et al., 1982). The geology of the INEL and the surrounding region has been the subject of numerous studies, and the reader is referred to the following references for detailed information: Nace et al., 1975; Embree, 1982; Spear and King, 1982; Rember and Bennett, 1979; Prestwich et al., 1980; Greeley, 1982; and Morris et al., 1962.

2.1.5 Geology of TAN

The geology of TAN is characterized by basalt flows with sedimentary interbeds overlain by lacustrine sediments from the ancestral Terreton Lake, and playa deposits from both Birch Creek and the Big Lost River. The lacustrine deposits are exposed at the surface in the southeastern portion of TAN. To the northwest, the deposits are overlain by 2 to more than 10 ft of Birch Creek playa deposits. The underlying basalt is a very dark, hard, tholeitic basalt that has shown distinct hexagonal jointing in excavations (Nace et al., 1956). Geologic descriptions from wells drilled in the TAN area indicate that the basalt exhibits a wide range of lithologic textures and structures, from dense to highly vesicular basalt and from massive to highly fractured basalt. Individual flow units have a median thickness of about 15 ft. The underlying interbeds at TAN, with a median thickness of about 4 ft, are much thinner than interbeds found elsewhere on the INEL, with a median thickness of about 10 ft.

Surface Geology. In general, TAN soils have formed as a result of alluvial or aeolian deposition over basalt lava flows and are derived from silicic volcanic and paleozoic rocks from the nearby mountains and buttes (Nace et al., 1956). Rock outcrops are common and some soils are relatively shallow.

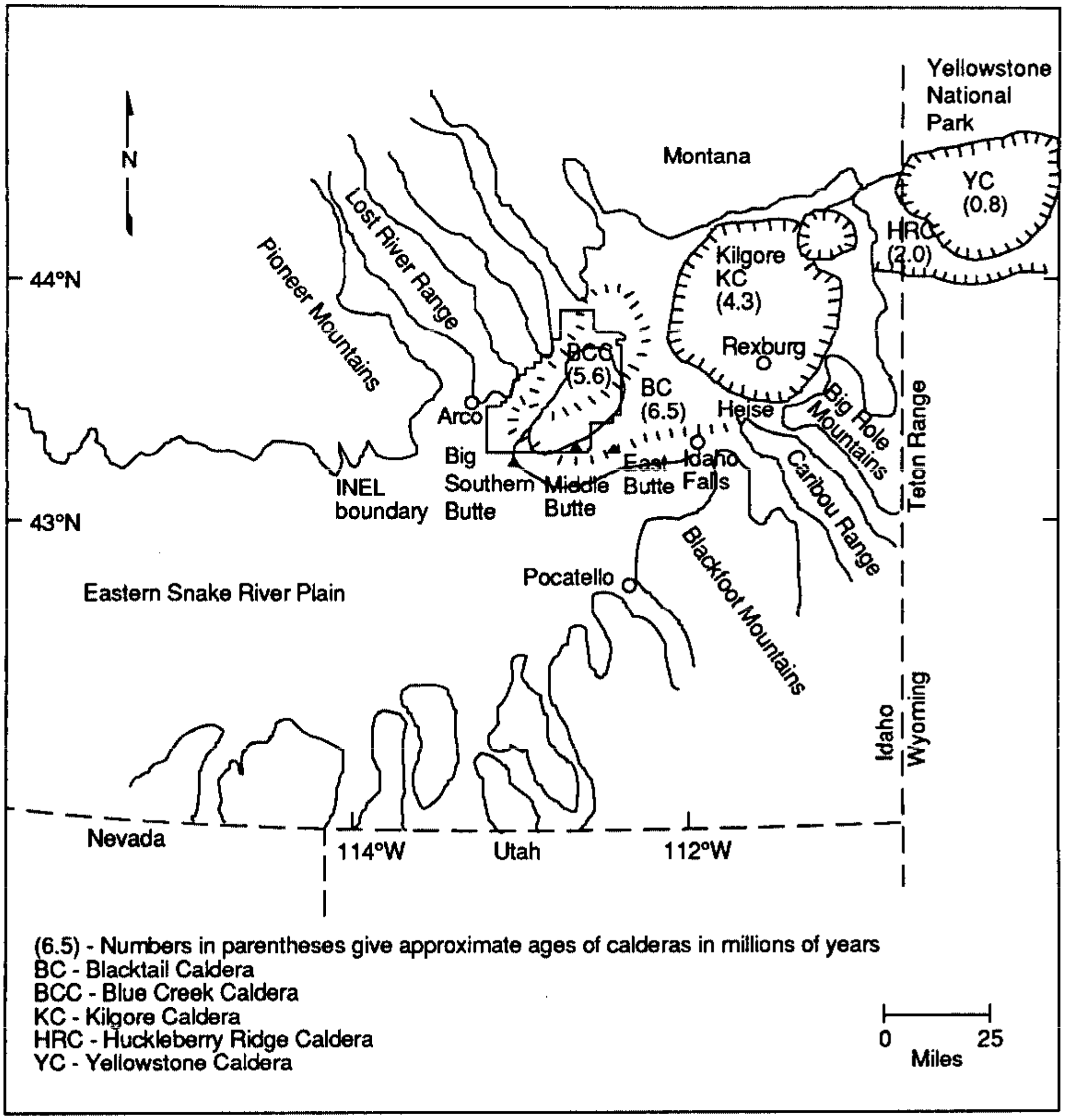

Figure 2-11. Rhyolite calderas of Yellowstone National Park and the Eastern Snake River Plain (Hackett et al., 1986).

Surface soils at TAN are primarily silt loams and silty clay loams derived from sediments in the ancient Lake Terreton (Martin et al., 1990). The clay size fraction at TAN is mostly clay and hydrous mica. Montmorillonite is more abundant than kaolinite, accounting for the presence of mud cracks on the soil surface. These soils also contain an appreciable amount of secondary calcite. The soils have high water-holding capacity but are nearly impermeable (Martin et al., 1990). Infiltration is through mud cracks, animal burrows, and root holes. Soils from TAN sampled during 1989 had the following soil properties: a pH of 7.95 to 8.78, a cation-exchange capacity of 14.27 to 30.42, and an organic carbon content of 0.37 to 1.94 (Martin et al., 1990).

Surficial sediments were collected from the lower portion of the Birch Creek drainage for the analysis of grain-size distribution, bulk mineralogy, and clay mineralogy. The deposits had a mean of 7.8 and a median of 2.5 weight percent in the less than 0.062 mm fraction. Bulk mineral analysis indicated mean percentages of quartz, calcite, feldspar, and dolomite to be 44, 28, 15, 4, respectively. Qualitative determination of the clay mineralogy for the samples indicated that illite was the dominant clay mineral present, with trace amounts of smectite and kaolinite, and the possible presence of mixed layer clays (Bartholomay and Knobel, 1989).

Wells drilled at TAN indicate that the thickness of the alluvium varies from 5 to 75 ft thick, with a decreasing thickness in alluvium to the east. The wide variation in the alluvial thickness is due largely to the irregular nature of the underlying basalt flows. The uppermost alluvial unit is the Birch Creek playa deposit that covers approximately 5 mi^2 to the west and northwest of TAN. These playa deposits consist of poorly sorted, fine-grained, light gray to light tan sand, silt, and clay that are typically reworked Lake Terreton sediments. The playa deposits are classified as clayey sandy silt with 14% clay, 20% sand, and 50 to 70% silt (Nace et al., 1956).

The Lake Terreton sediments generally underlie the playa deposits and are exposed at the surface in the southern and eastern portion of TAN. These deposits are typically clayey silt, with lesser amounts of relatively pure clay, silt, and fine gravel (Nace et al., 1956). Beach and bar deposits are also associated with the Lake Terreton deposits.

Subsurface Geology. Highly porous and fractured basalt rock underlies the relatively shallow soil at TAN. Numerous wells have been drilled in the TAN vicinity for various reasons, typically for water supply, injection, or monitoring (Figure 2-12).

Several lithologic types were encountered in interbeds within the basalt. Sedimentary interbeds of clay and silt material, which often contain clasts of basalt and interbeds consisting of basaltic breccia supported by a matrix of scoriaceous rubble are most common. The least common interbed is composed entirely of sandy material. Using available geologic and geophysical data from wells drilled at TAN, numerous interbeds have been identified. At or below the water table, two interbeds (P-Q and Q-R) can be correlated between wells. The P-Q and Q-R interbeds both consist of clay or silt. The P-Q interbed has been encountered in only approximately 40% of the wells drilled deep enough to show the interbed and therefore, appears to be laterally discontinuous (see the cross sections in Figures 1-5 and 1-6 in the Field Sampling Plan). To date, only three bore holes (TAN-CH1, USGS-7, and TAN-CH2) have been drilled deep enough to encounter the Q-R interbed, and in all cases the Q-R was present. An evaluation of hydrologic data suggests that the Q-R may be continuous and thus confining (see Section 2.1.6.6). This is indirectly supported by preliminary evaluations of basalt age dates that show a large age difference between flows above and below the Q-R interbed (personal communication from S. Anderson, USGS, to A. H. Wylie, EG&G Idaho, 1992). The 1.3 million year hiatus between basalt flows may have provided sufficient time for a laterally continuous Q-R interbed to be deposited. Therefore, the interbeds would represent subsurface geologic features that may influence contaminant migration in the groundwater system.

Bore hole televiewer logging of wells in the vicinity of TAN provide a detailed look at the lithostratigraphy and fracturing within the basalts beneath the ESRP. At the base of each flow is a narrow zone of rubbly material, which grades into a massive interior cut by near-vertical fractures or possibly columnar joints. Near the top is a narrow zone a few feet thick of shallow dipping fractures. This pattern of fractures in the basalts is most likely due to thermal stresses generated during cooling. Flows identified on the basis of this characteristic pattern have thicknesses of up

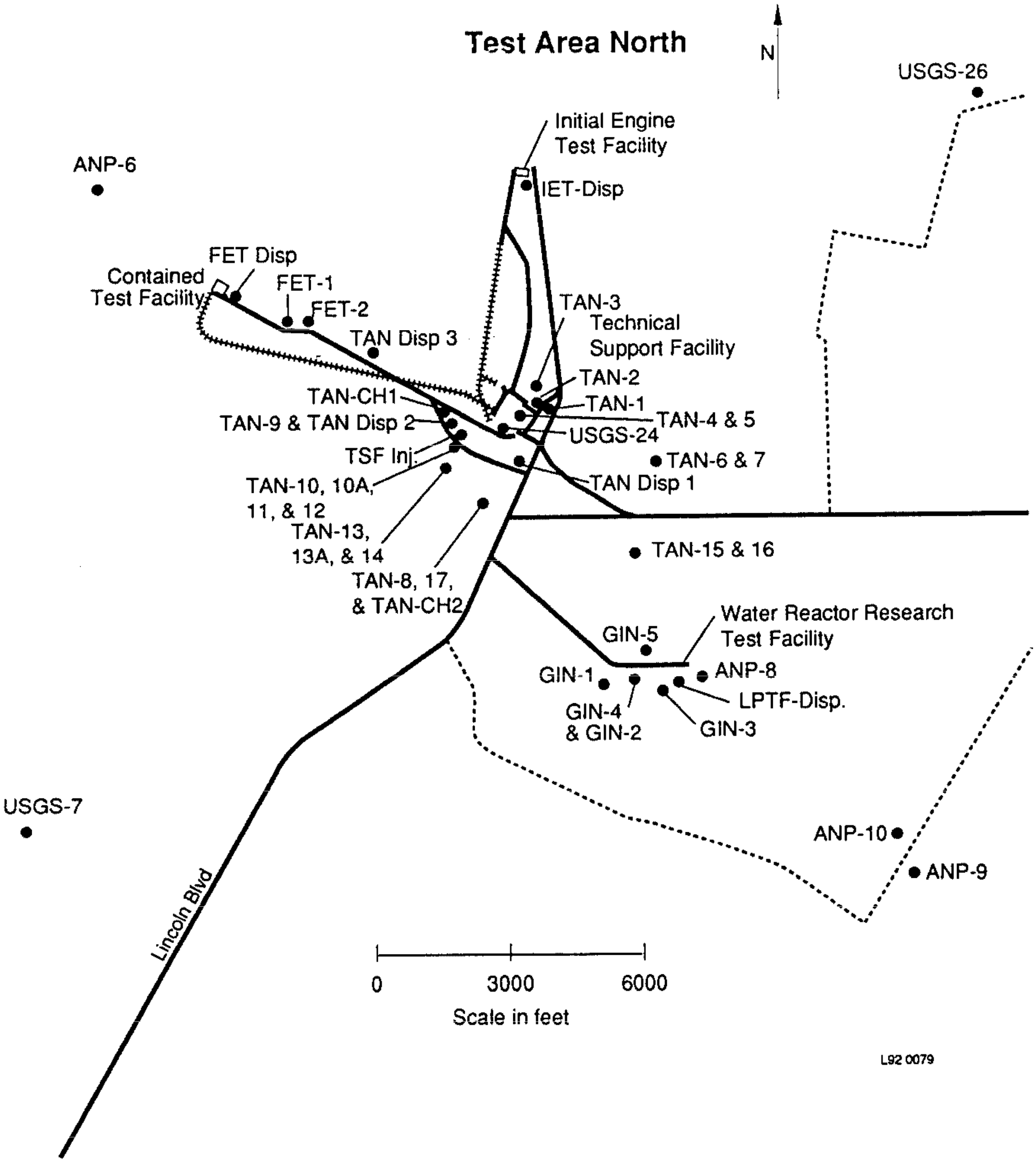

Figure 2-12. Locations of wells in the vicinity of TAN (see well equivalency table).

to 85 ft (Moos and Barton, 1990). Specific flow units between wells were not positively matched.

2.1.6 Hydrogeology

There are two documented water bearing zones at TAN. The shallowest zone is a small localized perched water zone about 50 ft below land surface (bls) in the surficial alluvium immediately under the TSF disposal pond. Because of the small, localized nature of the perched water, it does not have a significant impact on the groundwater system; therefore, it is not discussed below. The regional aquifer, the Snake River Plain Aquifer, is the second water-bearing zone and occurs at a depth of about 200 to 220 ft bls.

2.1.6.1 Snake River Plain Aquifer. The Snake River Plain Aquifer is defined as the series of saturated basalt flows and interlayered pyroclastic and sedimentary materials that underlie the Eastern Snake River Plain. The Snake River Plain Aquifer is approximately 200 mi long, 40 to 60 mi wide, and covers an area of 9,600 mi^2. It extends from Hagerman, Idaho, on the west to near Ashton, Idaho, northeast of the INEL (see Figure 2-1). Aquifer boundaries are formed by the contacts of the aquifer with less permeable rocks at the margins of the plain (Mundorff et al., 1964).

Flow within the aquifer takes place within a macroporous media. Permeability of the aquifer is controlled by the distribution of highly fractured basalt flow tops and interflow zones with some additional permeability contributed by vesicles and intergranular pore spaces. The variety and degree of interconnected water-bearing zones complicates the direction of groundwater movement locally throughout the aquifer (Barraclough et al., 1981). Although a single lava flow may not be a good aquifer, a series of flows may include several excellent water-bearing zones. If the sequence of lava that flows beneath the Snake River Plain is considered to constitute a single aquifer, it is one of the world's most productive (Mundorff et al., 1964).

Robertson et al. (1974) estimated that as much as 2 billion acre-ft of water may be in storage in the aquifer, of which about 500 million acre-ft are recoverable. Later estimates suggest the aquifer contains about 400 million acre-ft of water in storage.[a] The aquifer discharges about 7.1 million acre-ft of water annually to springs and rivers. Pumpage from the aquifer for irrigation totals about 1.6 million acre-ft annually (Hackett et al., 1986).

Recharge to the aquifer occurs mostly through infiltration of irrigation water (5.1 million acre-ft) and from valley underflow (1.5 million acre-ft) from the 35,000 mi^2 of recharge area in the surrounding mountains to the north and northeast of the plain (Hackett et al., 1986). Recharge from river seepage amounts to about 1.3 million acre-ft, and direct recharge from precipitation falling on the plain is estimated at 0.8 million acre-ft/yr.

Recharge to the Snake River Plain Aquifer from within INEL boundaries is primarily in the form of infiltration from the rivers and streams draining the areas to the north, northwest, and northeast of the Snake River Plain. In most years, spring snowmelt produces surface runoff that accumulates in depressions in the basalt or in playa lakes. On the INEL, water not lost to evapotranspiration recharges the aquifer because the INEL is in a closed topographic depression. Significant recharge from high runoff in the Big Lost River causes a regional rise in the water table over much of the INEL. Water levels in some wells have been documented to rise as much as 6 ft following very high flows in the Big Lost River (Pittman et al., 1988).

Water table contours for the Snake River Plain Aquifer below the INEL are depicted in Figure 2-13. The regional flow is to the south-southwest; although, locally, the direction of groundwater flow is affected by recharge from rivers, surface water spreading areas, and inhomogeneities in the aquifer. Across the southern INEL, the average gradient of the water table is approximately 2 ft/mi or 0.00038 ft/ft (Lewis and Goldstein, 1982). The hydraulic gradient for the regional aquifer in the vicinity of TAN is about 1 ft/mi (Lewis and Jensen, 1984). Depth to water varies from about 200 ft in the northeast corner of the INEL to 1,000 ft in the southeast corner. The depth to water at TAN varies from slightly less than 200 ft at the TSF injection well to over 350 ft at ANP-7, a well located in the northern portion of TAN.[b]

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a. Private communication with J. T. Barraclough, 1989.

b. Unpublished data, G. J. Stormberg, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 1990.

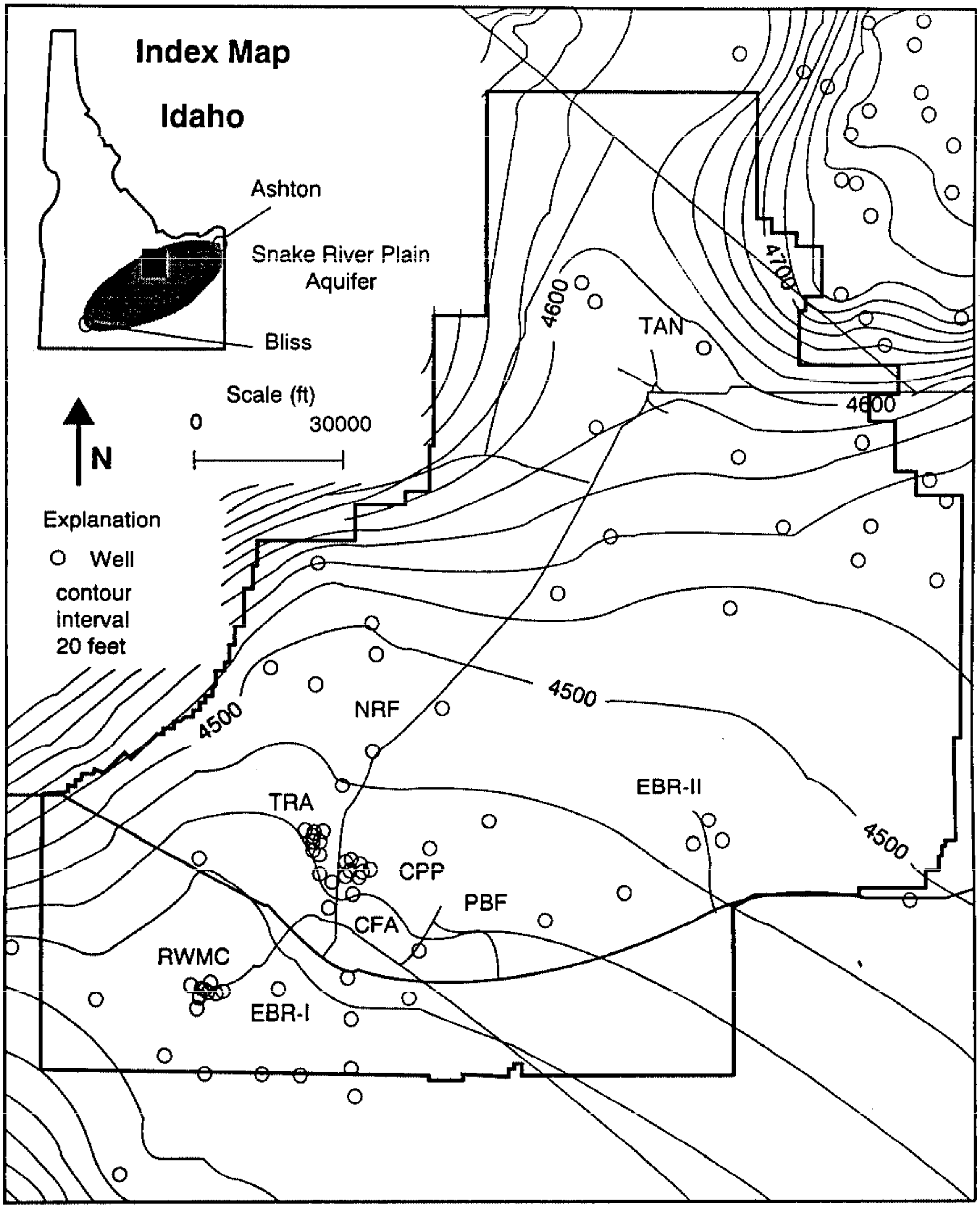

Figure 2-13. Elevation of the water table for the Snake River Plain Aquifer, May, 1989.

2.1.6.2 Aquifer Thickness. The thickness of the active portion of the Snake River Plain Aquifer at the INEL has been estimated between 250 and 820 ft by the USGS. Drilling information from a deep geothermal test well, INEL-1, located 2.5 mi north of the TRA suggests an active flow system thickness of between 440 and 820 ft (Mann, 1986). Drilling of TAN core hole 2 just south of TSF suggests that the aquifer thickness in the vicinity of TAN may be greater than 900 ft. An earlier study by Robertson et al. (1974) estimated the thickness of the active portion of the aquifer to be much less than 400 ft. That study, based on a mass balance of tritium disposal from INEL facilities, determined the thickness of the active portion of the aquifer to be 250 ft. That finding is based on the depth that discharged tritium is mixed with water in the aquifer and on an assessment of the geology.

It is not clear which estimate is correct; however, aquifer thickness will vary between areas and a distinct boundary probably does not exist. With depth, the aquifer becomes less and less active in the regional groundwater system because of decreasing hydraulic conductivity.

2.1.6.3 Aquifer Parameters. Aquifer tests have been conducted on wells completed in the Snake River Plain Aquifer to determine the wells' suitability for water supply and in support of regional studies conducted by the USGS (Mundorff et al., 1964, and Wood, 1989). Many tests were conducted by the USGS during the 1950s. Data from those tests, which used high pumping rates, have been compiled and were used to estimate the transmissivity and storage coefficients of the aquifer at TAN. The best transmissivity estimates range from a low of 400 ft^2/day in the TSF injection well to a high of 800,000 ft^2/day in well ANP-6 with a median value of 38,500 ft^2/day (see Table 2-4). These data suggest that wells near TAN have a relatively low transmissivity compared to the INEL regional aquifer transmissivity, which is estimated to be 270,000 to 400,000 ft^2/day (Robertson et al., 1974). This is probably due to the short open interval in the wells rather than a local decrease in transmissivity. None of the nine wells tested fully penetrate the aquifer; therefore, the transmissivity of the local aquifer in the vicinity of TAN may be somewhat higher.

Aquifer storativity at TAN ranges from 0.003 to 0.01, with 0.01 as the best estimate (Wood, 1989). 0.01 is within the range of storativity values

Table 2-4. Transmissivities and storativities for wells in the TAN area, based on pumping test evaluations, 1953-1987[a]

Wells					
INEL[c]	USGS	Date of Test	Transmissivity (gpd/ft x 10^5)	Transmissivity (ft^2/day)	Storativity
TAN-1	6N-31E-13ac1	4/16-17/53	7.0	33,000	0.01
		4/30/53	9.5		0.01
		7/20-23/53	6.4		0.01
		11/17/87	2.5 best		0.005
TAN-2	6N-31E-13ac2	11/22-23/53	6.4	12,000	0.01
		11/18/87	0.9 best		0.004
ANP-6	6N-31E-10ac1	9/5-6/56	60 best	800,000	---
	6N-31E-10ac1	7/10/87	<0.2		
TSF-INJ[b]	6N-31E-13ab1	7/13/87	0.03	400	---
IET-DISP	6N-31E-12-acd1	7/09/87	0.4	5,400	---
FET-1	6N-31E-14ab1	4/17-18/58	3.3	44,000	---
FET-2	6N-31E-14ab2	5/03/58	6.8	91,000	---
FET-disp.	6N-31E-11cd1	11/23-24/57	5.0 - 10	100,000	---
LPTF	6N-32E-22cc1	6/20-21/57	0.3	4,000	---
USGS 24	6N-31E-13DB1	ob. well	21 not accurate	280,000	0.003

a. Wood, 1989 (see Appendix J).

b. Aquifer coefficients calculated from tests conducted on the TSF injection well may not be indicative of the surrounding aquifer. The materials disposed in the well may have impacted the aquifer's ability to transmit water.

c. See well equivalency table in the front of the Work Plan.

(0.01-0.06) estimated for the regional aquifer underlying the entire INEL (Robertson et al., 1974).

The calculated hydraulic conductivity at TAN, based on pumping tests, ranges from a low of 5 ft/day at the TSF injection well to 2,700 ft/day at well USGS 24 (Wood, 1989). Slug tests performed on wells at TAN in 1989 and 1990 were analyzed using the Hvorslev (1951), Bouwer and Rice (1976), and Vanderkamp (1976) techniques to determine the horizontal hydraulic conductivity. The horizontal hydraulic conductivity values from slug tests range from 0.20 ft/day to 500 ft/day (see Table 2-5). The results of the slug tests and the aquifer test performed on the TAN wells demonstrate that the aquifer is not homogeneous and isotropic, and that there is considerable variation in the horizontal hydraulic conductivity at TAN.

2.1.6.4 Direction and Control of Groundwater Flow. Past research defining a contaminant plume from the Idaho Chemical Processing Plant (ICPP) near the Central Facilities Area (CFA) has shown that the ICPP plume generally follows the direction of the regional water table gradient (Nace et al., 1956; Barraclough et al., 1981). It has been suggested from a hydraulic perspective that the Snake River Plain Aquifer can be conceptualized as a macroporous medium, where the individual grains are tens to hundreds of feet in diameter. Flow through the aquifer would follow a sinuous path around, through, and between the large particles, in the general direction of the regional hydraulic gradient. Thus, while the prevailing movement of water is horizontal, some component must be vertical as individual flow paths migrate around the macro grains. Figure 2-14 is a regional water table map of the TAN area showing the inferred direction of groundwater flow for December 1990. Appendix F contains regional water table maps for January 1990 through December 1990.

Figure 2-15 is a water table map of the TAN area for December 1990 with flow lines showing the direction of groundwater flow. The flow path is from the TSF-05 injection well to the TAN-1 production well. The map also shows flow from just outside the (pumping) influence of TAN-1 proceeding down to ANP-8 (WRRTF production well) and then down-gradient.

Table 2-5. Preliminary analysis from TAN area slug tests

WELL	Hvorslev K (ft/day)	Bouwer & Rice K (ft/day)	Vanderkamp K (ft/day)	Average K (ft/day)
TAN3-1	-	-	170	180
TAN3-2	-	-	190	
TAN4-1	^	25	*	30
TAN4-2	^	34	*	
TAN5-1	-	-	300	340
TAN5-2	-	-	300	
TAN5-3	-	-	310	
TAN5-4	-	-	420	
TAN6-1	14	12	*	14
TAN6-2	16	13	*	
TAN7-1	-	-	48	48
TAN7-2	-	-	48	
TAN8-1	11	9	*	10
TAN8-2	11	11	*	
TAN9-1	36	22	*	28
TAN9-2	32	23	*	
TAN10-1	-	-	500	500
TAN10-2	-	-	500	
TAN10-3	-	-	500	
TAN10A-1	36	26	*	31
TAN10A-2	37	25	*	
TAN11-1	19	14	*	16
TAN11-2	17	15	*	
TAN12-1	3.8	3.6	*	3.7
TAN12-2	4.0	3.3	*	
TAN13A-1	16	13	*	14
TAN13A-2	15	12	*	
TAN14-1	0.22	0.21	*	0.23
TAN14-2	0.25	0.24	*	
TAN15-1	-	-	51	64
TAN15-2	-	-	81	
TAN15-3	-	-	61	
TAN16-1	-	-	110	120
TAN16-2	-	-	130	
TAN16-3	-	-	130	

* The Vanderkamp method was only used to evaluate slug tests experiencing excessive oscillations.
\- The Hvorslev and Bower and Rice methods were not applicable due to excessive oscillations.
^ The Hvorslev method was not used because well was screened across the water table.

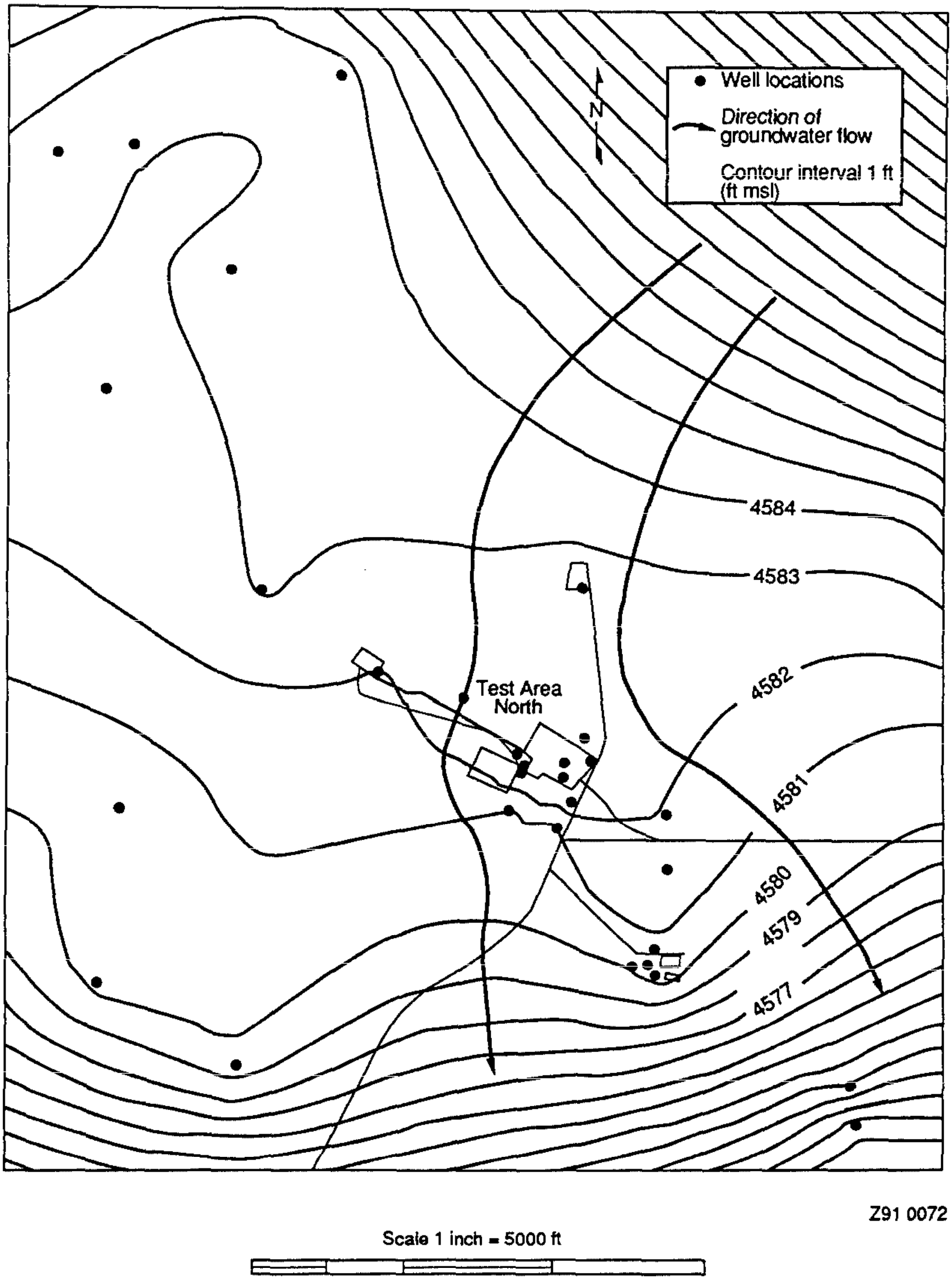

Figure 2-14. Water table map of the TAN area showing the inferred direction of groundwater flow.

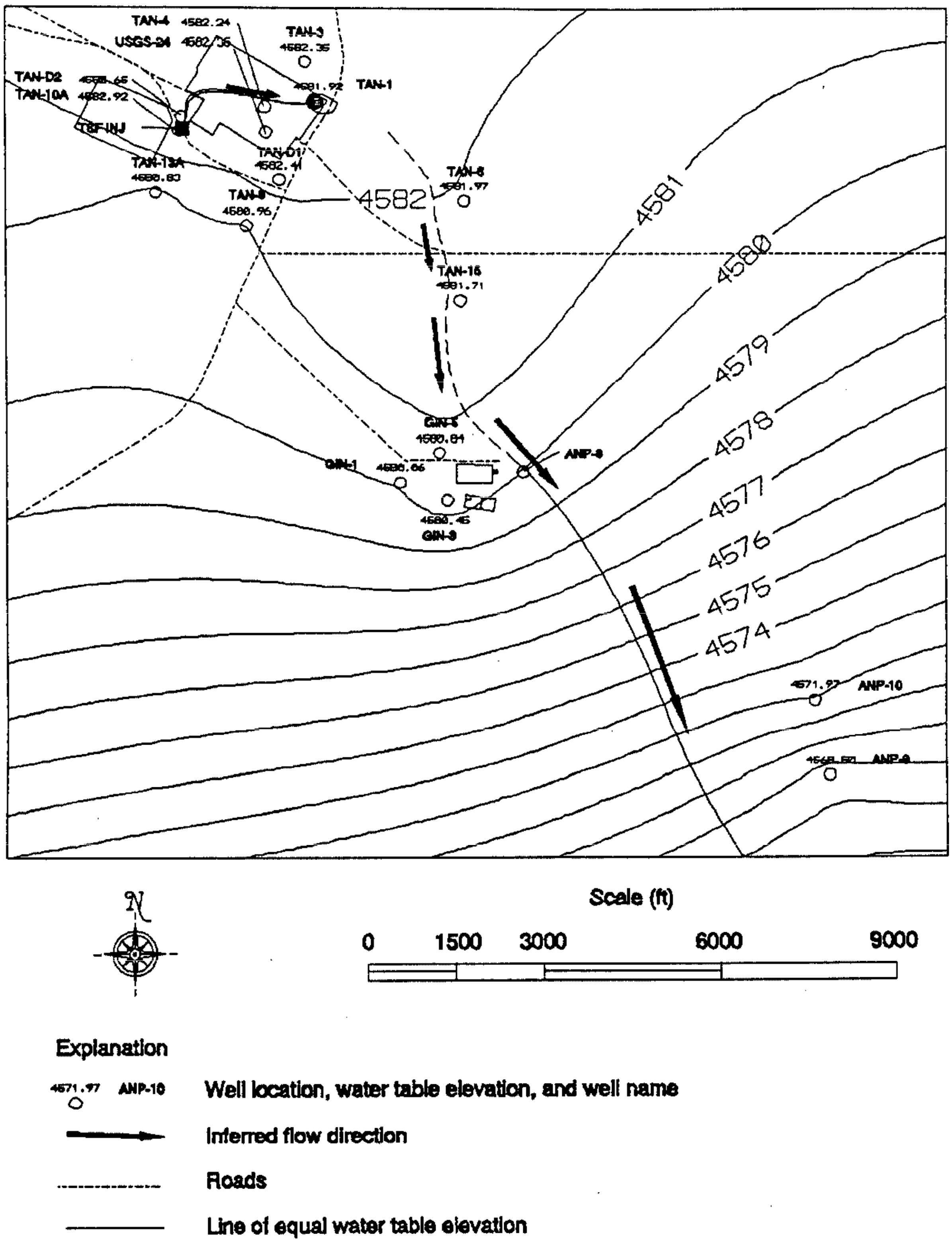

Figure 2-15. December 1990 water table map for TAN area with inferred direction of groundwater flow.

Figures 2-16a and 2-16b are water table maps of the TSF area at TAN showing the effects when the TAN-1 production well is pumping at 1,060 gpm and with minimal production well influence, respectively. These two maps are characteristic of the conditions at TAN and both show that the TAN production wells produce a depression within the hydrologic system. Under the current conditions, it is difficult to envision how the contaminant plume escaped from this depression. Perhaps occasionally pumping rates are reduced over holiday weekends allowing some of the contaminants to escape the influence of the production wells.

2.1.6.5 Rate of Flow. The groundwater flow velocity in the vicinity of TAN is estimated to range from a low of 0.003 ft/day to a high of 6.0 ft/day, with a median value of 0.3 ft/day. This assumes a low, high, and median transmissivity value of 400, 800,000, and 38,500 ft^2/day, respectively; and a hydraulic gradient of 1 ft/mi, an aquifer thickness of 250 ft, and a porosity of 0.10.

Groundwater velocity can also be obtained using contaminants as tracers. Using USGS sampling data, a curve of specific conductance versus time can be created (Figure 2-17). Historical records indicate that injection began in the TSF injection well in 1955 and the maximum concentration levels reached USGS-24 in 1965. Mechanical dispersion and molecular diffusion will cause some of the contaminants to move faster than the average linear velocity of the water and some will move slower. Therefore, the average groundwater velocity is calculated using the arrival of a concentration representing one half the maximum concentration level (Freeze and Cherry, 1979). This concentration level reached USGS-24 in 1964. Using this information, the contaminants traveled 1425 ft in 3287 days for an average groundwater velocity of 0.43 ft/day.[c] This is much slower than the average velocity of 5 to 10 ft/day for the INEL (Robertson et al., 1974). The slower groundwater velocity observed at TAN is a result of the lower gradient and lower hydraulic conductivity.

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c. Unpublished data, A. H. Wylie, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 1990.

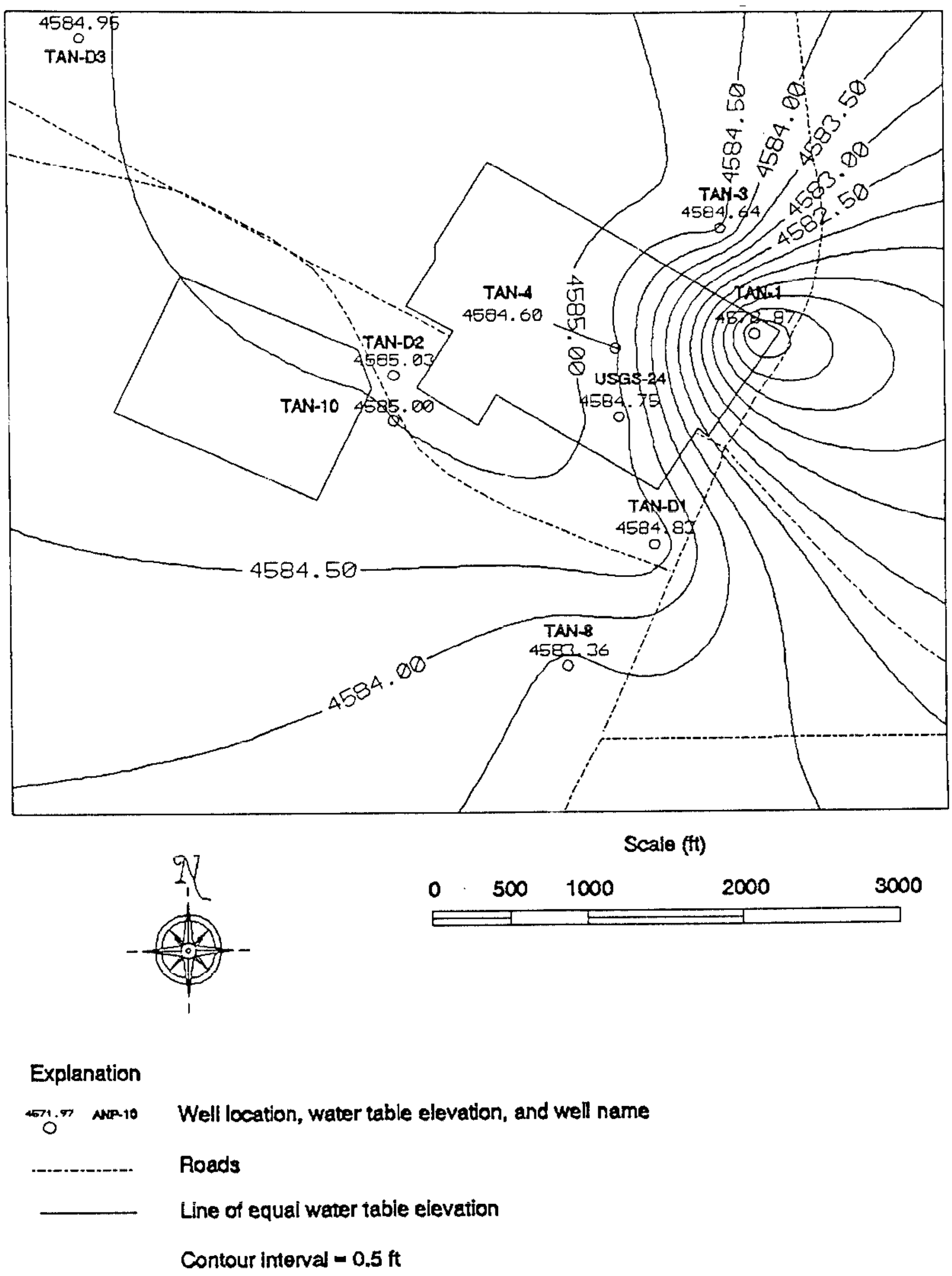


Figure 2-16a. May 1990 water table map for TAN showing the effects of pumping (pumping rate 1,060 gpm) (the software Surfer was used for contouring).

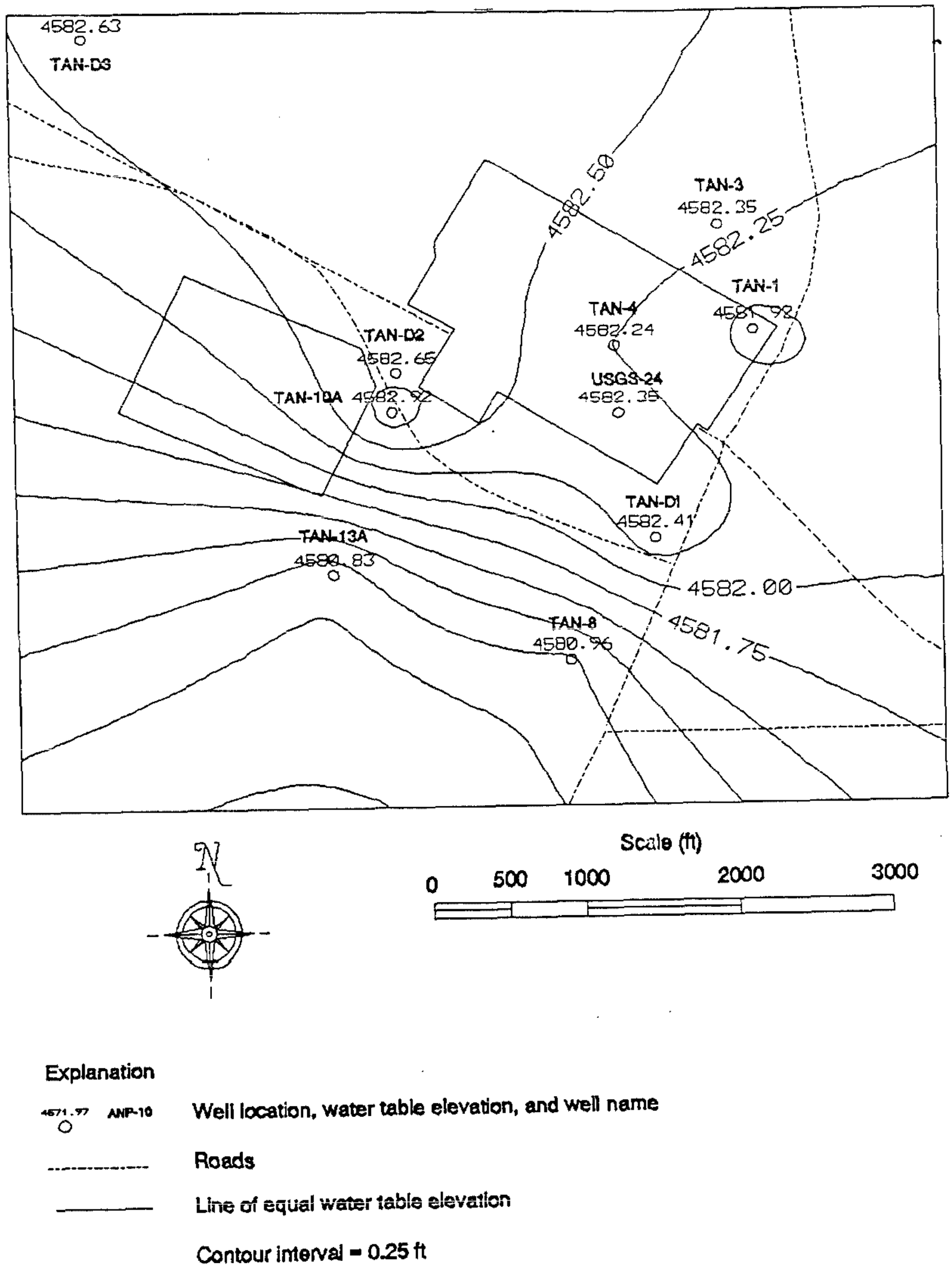


Figure 2-16b. December 1990 water table map for TAN with minimal effects from pumping (the software Surfer was used for contouring).

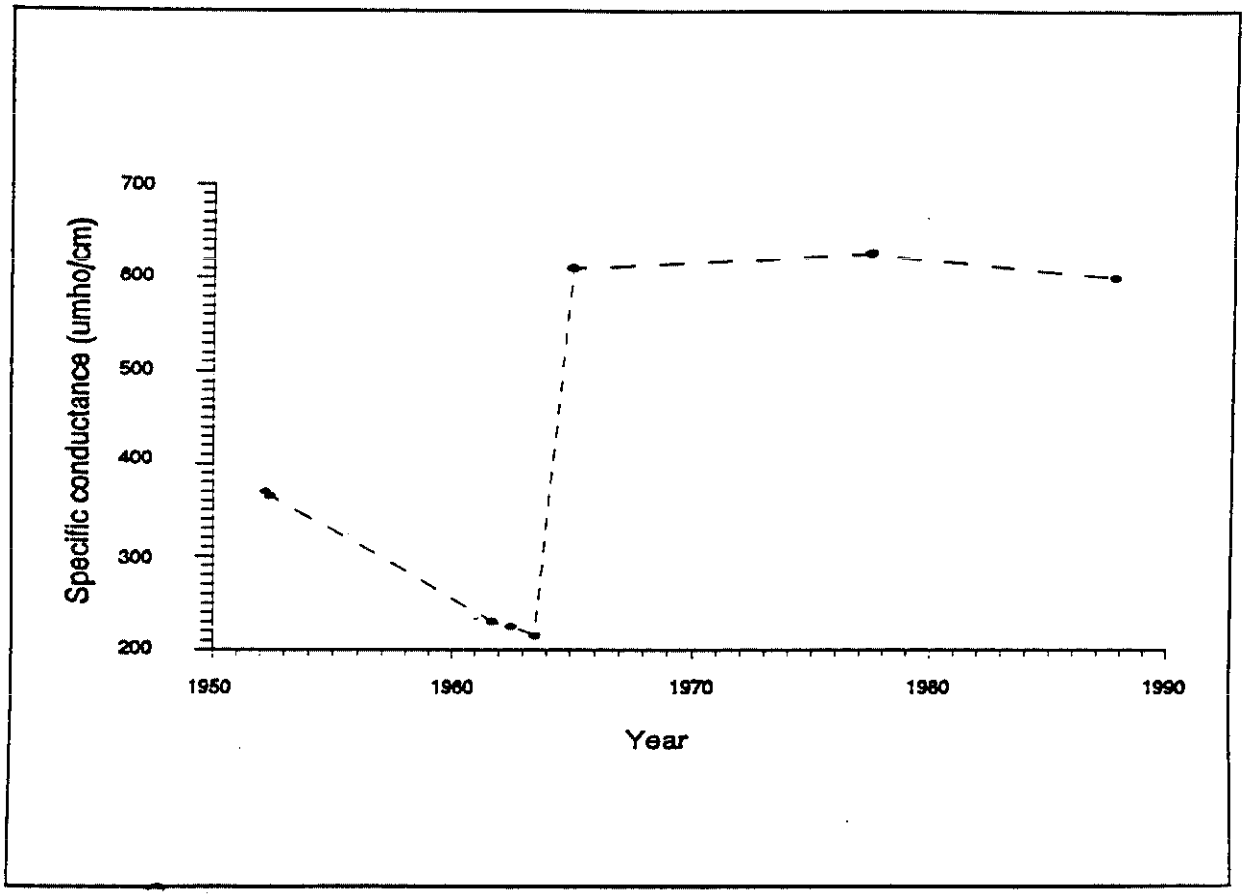


Figure 2-17. Specific conductance concentration at USGS 24.

2.1.6.6 Vertical Flow. The average vertical hydraulic gradient at TAN is downward at approximately 0.01 ft/ft. The well pair TAN-15 and TAN-16, located north of WRRTF, shows an upward gradient of 0.001 ft/ft. This suggests that the area from TSF northward is a recharge area. Perhaps this is a remnant from when Birch Creek would flow onto the INEL and infiltrate into the aquifer in Birch Creek Playa.

It is also possible that the hydraulic conductivity distribution is affecting the vertical gradients. It is conceivable that as the flow paths migrate around the macroporous media (described in Sections 2.1.6.1 and 2.1.6.4), well pairs placed adjacent to large relatively impermeable blocks could give an incorrect assessment of the overall vertical gradient. In such a case, the measured gradient would reflect the vertical component of flow for the flow path migrating through the macroporous media, not the overall vertical gradient. Due to this phenomenon, large vertical separation between paired wells will be needed to accurately measure the vertical gradient. The macroporous media model suggests that flow takes place between large, room-sized blocks. If this is the case, the vertical separation between wells would need to be on the order of 100 ft or more and be hydraulically connected to the same fracture system to average out the effects of highly permeable zones and allow an accurate evaluation of vertical flow.

The observed vertical gradient between adjacent wells TAN-CH2S and TAN-8 requires additional explanation. TAN-CH2S has a head of about 10 ft higher than that in TAN-8 for an upward gradient of 0.04 ft/ft. Neither the recharge theory nor the macroporous media model can explain this observation. Possible explanations include the following:

- TAN-CH2S is plugged
- A remnant head is from the 1969 flood
- A residual head is from the injection well
- Pumpage has lowered the head in the near surface portion of the aquifer
- TAN-CH2S is completed in a lower confined portion of the aquifer and is in communication with higher up-gradient heads.

All of these possible explanations will be analyzed in detail below.

The well is plugged: To maintain a 10-ft head, the well would have to be completed in impermeable sediments. Even if the well was completed in dense basalt having a hydraulic conductivity of two orders of magnitude below the lowest measured in other TAN basalts, the well would have recovered from a 10-ft slug of water in a matter of days. A slug test will be conducted to further check this possibility.

Remnant head from the 1969 flood: Although flooding could create mounding in the aquifer, it is difficult to envision a mechanism that could store the 10-ft head for 23 years 292 ft below the water table.

Residual head from the injection well: Although injection could create mounding at the point of injection, the injection well's total depth is about 95 ft above the Q-R interbed and the observed 10-ft head is below the Q-R interbed (Figure 2-18). Also, the injection well has been inactive for about 20 years.

Both of the last two mechanisms discussed require storing and gradually bleeding off an equivalent flux of about 7 million gallons a day. It is difficult to envision a mechanism for storing and gradually releasing such a flux in a highly transmissive aquifer with low storage potential such as the Snake River Plain Aquifer.

Pumpage has lowered the head in the near surface portion of the aquifer: In 1990, the TAN production wells pumped about 70,000 gpd, and these wells both pump from above the Q-R interbed. This discharge pumping could possibly lower the water table within the vicinity of the TSF. However, about 96% of this water is returned to the aquifer through infiltration ponds (see water balance in Appendix I). Therefore, the net loss is only a fraction of the volume pumped. It is unlikely that pumping at TAN could cause the observed 10-ft head difference.

TAN-CH2S is completed in a lower confined portion of the aquifer and is in communication with higher upgradient heads: A cross-section constructed through TAN-CH2 indicates that an interbed separates TAN-CH2 and TAN-8

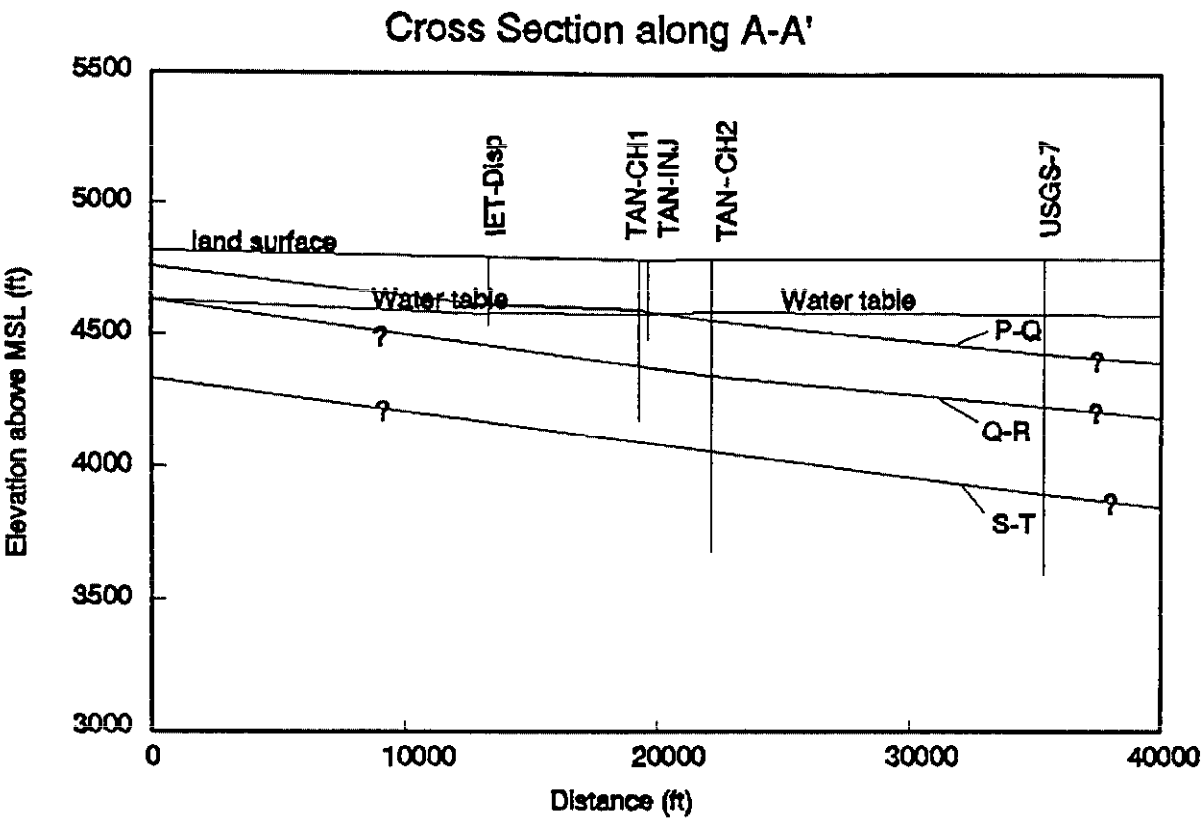
(Figure 2-18). A three-point problem conducted using TAN-CH1, TAN-CH2, and USGS-7, which penetrate the Q-R interbed (Figure 2-19), indicates that the interbed has a strike about straight east-west, with a dip of about 1° south. If the interbed is projected to the north, the Q-R interbed should subcrop at the water table at an elevation of about 4600 ft. Figure 2-20 illustrates the flow system as it is explained by this hypothesis. Thus, TAN-CH2 is possibly in communication with higher up-gradient heads.

The most likely scenario explaining the observed 10-ft head difference between TAN-CH2S and TAN-8 would appear to be a combination of the last two scenarios. Pumpage from the TAN water supply wells creates lower-than-expected heads in an upper unconfined aquifer and a separate lower confined system is in communication with up-gradient heads, creating higher-than-expected heads below the Q-R interbed. This hypothesis will be tested by:

- Completing well pairs so that one well is above and one well is below the Q-R interbed to see if the observed head difference is repeated
- Locating a well pair within the influence of the TAN production wells to see if pumping effects can be detected below the Q-R interbed.

2.1.6.7 Water Quality. Water in the Snake River Plain Aquifer shows a chemical composition reflecting the source area of the recharge (Robertson et al., 1974). Recharge from the north and northwest is derived from clastic and carbonate sedimentary rocks and is, therefore, a calcium bicarbonate-type water. Recharge from the east is derived from silicious volcanic rocks, and water is somewhat higher in sodium, fluoride, and silica. Groundwater at TAN is of the calcium bicarbonate-type indicative of recharge from the north and northwest.

2.1.6.8 Water Balance. A water balance was calculated to estimate the effects infiltration from the TAN TSF-07 Disposal Pond might have on the aquifer potentiometric surface (see Appendix I). Only the TAN TSF-07 disposal pond was considered because all other ponds in the vicinity of TSF are designed to handle flood/surface water drainage. These ponds do not receive discharge unless there is overland flow at TSF. The data and assumptions used in these calculations include flux into the ponds obtained from the Industrial



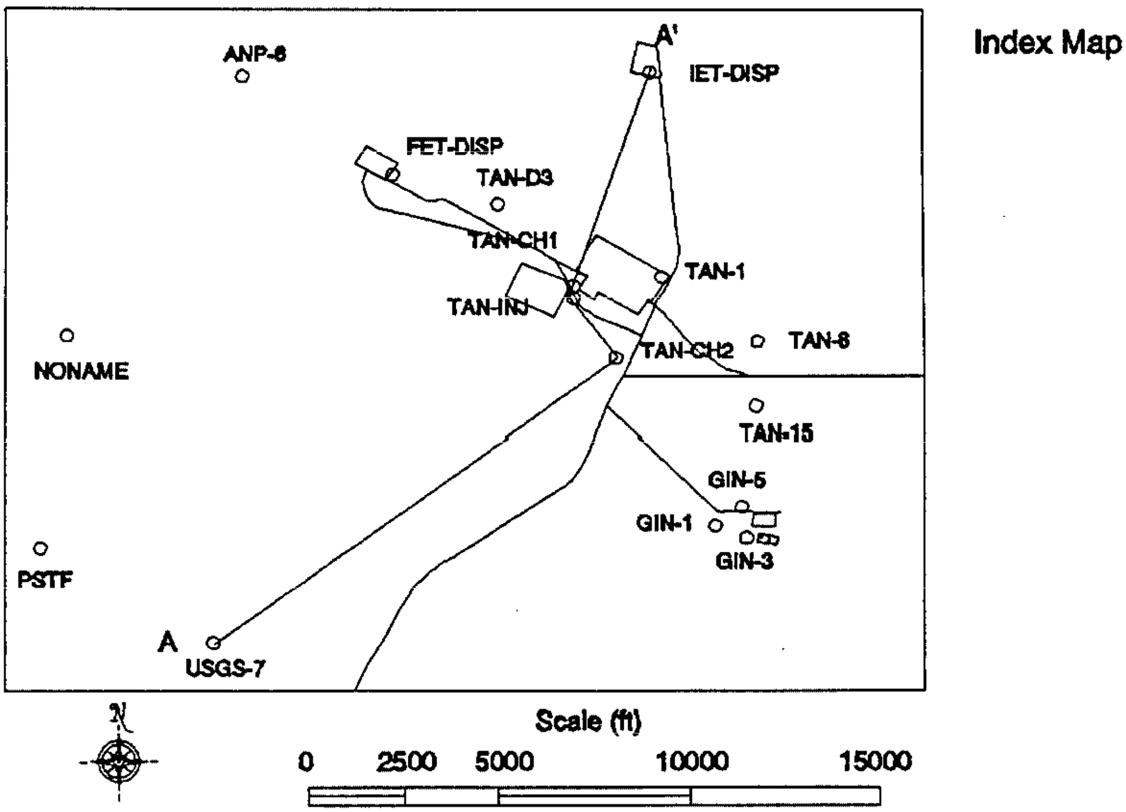


Figure 2-18. North-south cross-section through TAN showing subsurface interbeds and the water table.

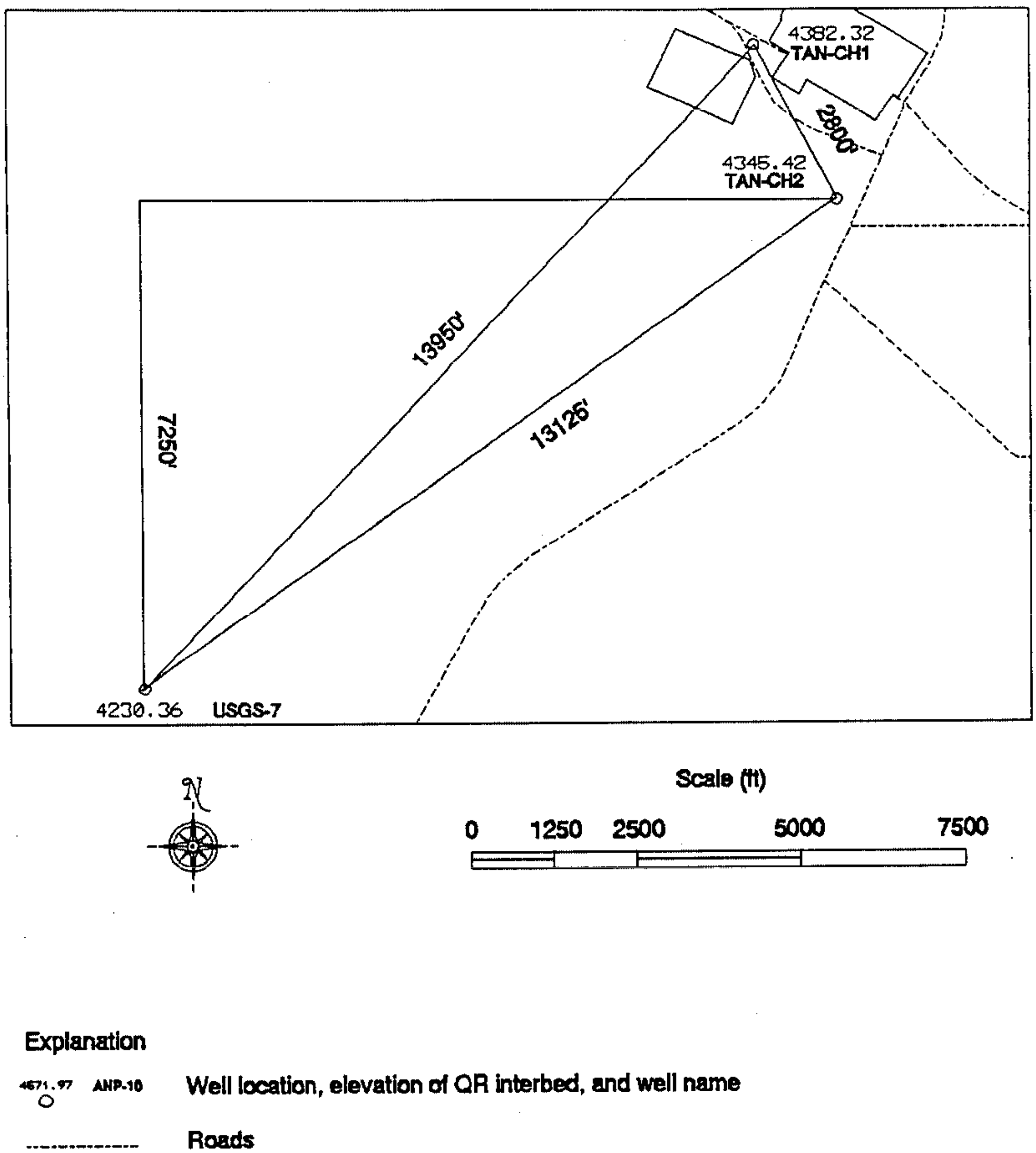


Figure 2-19. Three point problem conducted on the top of the Q-R interbed.

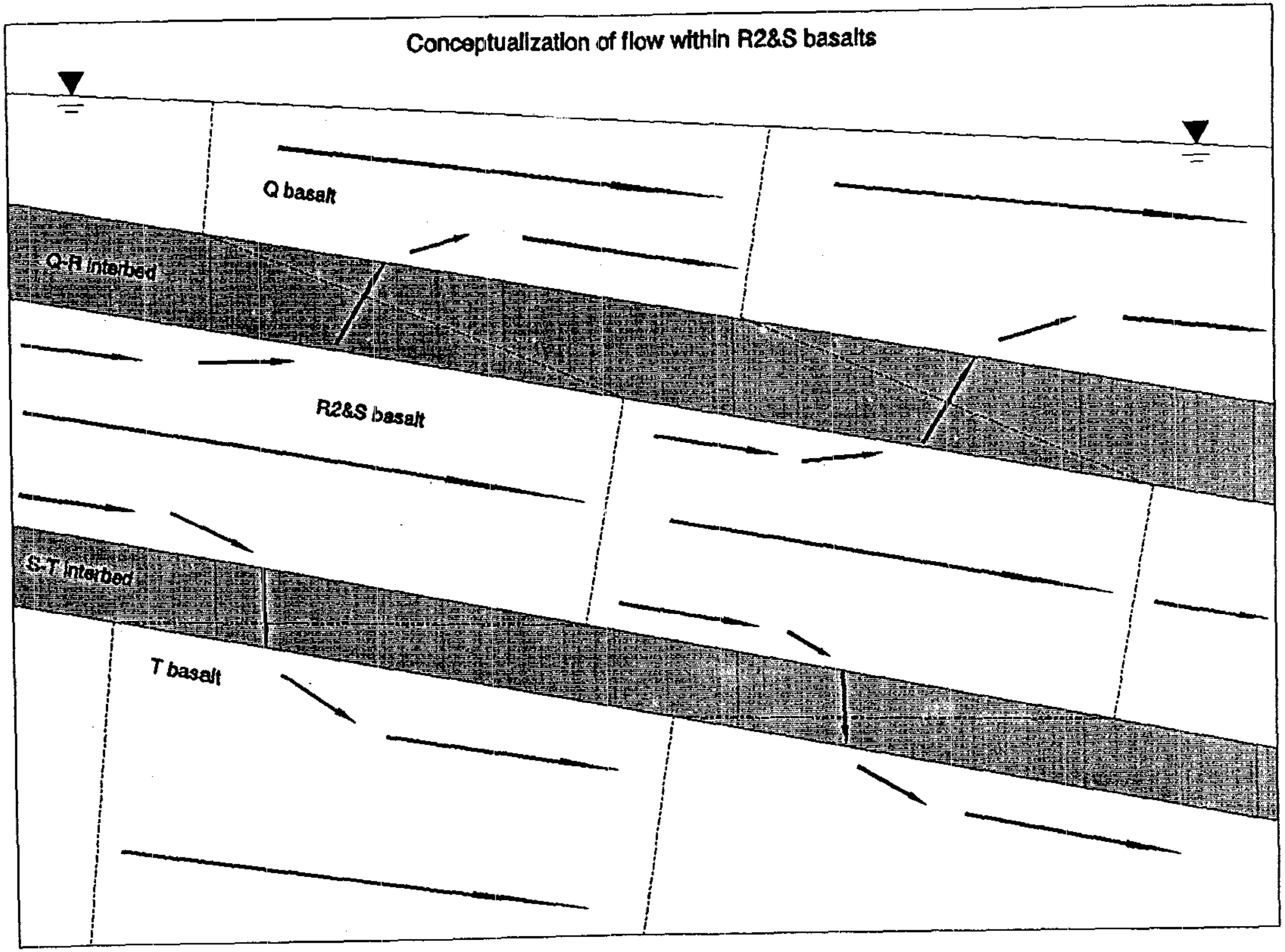


Figure 2-20. Conceptualization of groundwater flow within the R2&S basalts.

Waste Management Information System (IWMIS), hydraulic conductivity data obtained from aquifer tests, pan evaporation data from NOAA, and assuming the pond and associated perched water body are in steady state. The calculated infiltration rate is about 270,000 ft^3/mo (46 gal/min), the calculated area of the perched water body is 220,000 ft^2, and the calculated rise in the water table beneath the perched water body is about 0.2 ft. Because the disposal pond is located up-gradient from the injection well, this mounding probably does not create an area of radial flow within the plume.

2.1.7 Ecology

The INEL is located in a sagebrush ecosystem commonly found in the cold desert region of the Great Basin (Figure 2-21). The sagebrush ecosystem is characterized by shrubs with an understory of perennial grasses and forbs (Anderson et al., 1978). The INEL includes over 20 vegetation communities and almost 400 plant species. Sagebrush provides the largest habitat on the INEL and is important to many animal species that inhabit or utilize the area. All plant species at the INEL have been compiled in a computer data system (Floyd and Anderson, 1983) and additional plant summaries are available for the Site (Cholewa and Henderson, 1983; Floyd and Anderson, 1983; Marlette and Anderson, 1983; Arthur et al., 1983; McBride et al., 1978; and Shumar, 1983).

The INEL also supports a diverse population of birds, mammals, amphibians, and reptiles. These fauna have been extensively studied, and the reader is referred to available documents for detailed results of this research (Connelly, 1982; Connelly and Ball, 1983; Craig et al., 1979, 1983; Gates, 1983; Gleason, 1978; Groves and Keller, 1983; Halford and Markham, 1983; Johnson and Anderson, 1983; Markham, 1987; McBride et al., 1978; Peterson and Best, 1983; Reynolds and Rose, 1978; Stafford and Barr, 1983; Stafford, 1984; Stoddart, 1983; Wilde and Keller, 1978; Arthur et al., 1983).

2.1.7.1 Threatened and Endangered Species. There are no known species listed as endangered or threatened by the U.S. Fish and Wildlife Service (50 CFR 17.11, 17.12) residing year-round on the INEL and no known critical habitats (Reynolds et al., 1986; U.S. Fish and Wildlife Service, 1990).

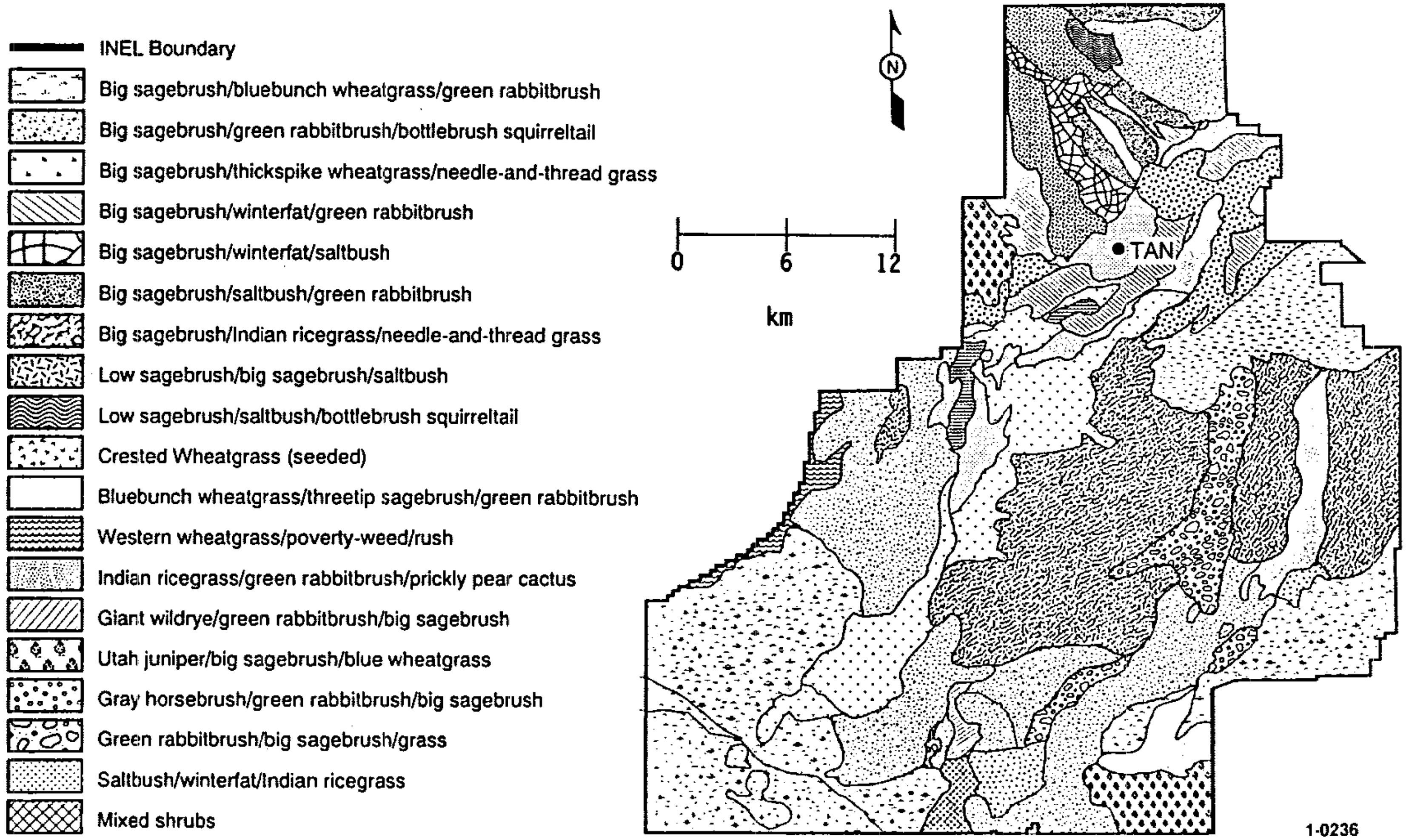


Figure 2-21. Generalized map of vegetation distribution on the INEL.

One resident species of milkvetch (Astragalus ceramicus Sheld. var. apus Barneby) that was being reviewed for endangered or threatened federal status was discovered on the northern INEL (Cholewa and Henderson, 1984). Since then, this species has been removed from candidate status (Moseley and Groves, 1990). Oxytheca (Oxytheca dendroidea Nutt.), found at the Central Facilities Area and to the northeast, but not known to occur near TAN (Cholewa and Henderson, 1984), is currently listed by the State of Idaho as imperiled (Moseley and Groves, 1990).

The bald eagle (Haliaeetus leucocephalus) and the peregrine falcon (Falco peregrinus) are the only animals observed on the INEL that are classified by the U.S. Fish and Wildlife Service as endangered (U.S. Fish and Wildlife Service, 1990). Bald eagles winter on or near the INEL. The peregrine falcon has been observed infrequently in the northern portion of the INEL. The ferruginous hawk (Buteo regalis), long-billed curlew (Numenius americanus), and Townsend's big-eared bat (Plecotus townsendi) are candidate species for the list of threatened and endangered species that appear on the INEL (U.S. Fish and Wildlife Service, 1990). In addition, the merlin (Falco columbarius), which is considered a rare breeding and year-round resident species (Reynolds et al., 1986), is listed as a species of special concern in Idaho (Moseley and Groves, 1990).

2.1.7.2 Archeology. The northern portion of the INEL is marked physiographically by several features including the flat basin once occupied by Pleistocene Lake Terreton, the Big Lost River/Birch Creek Sinks which form the only existing remnant of Lake Terreton, a large and flat alluvial fan originating in the Birch Creek Valley, and large islands of Tertiary lava of which Circular Butte, Antelope Butte, Richard Butte, and Scott Butte are parts. Less conspicuous features include low wave-cut terraces, sand dunes, and now abandoned channels of the Big Lost River and Birch Creek. Archaeological surveys as summarized by Ringe[d] have crosscut many of these features and provide information on the distribution of cultural resources in relation to them. In general, prehistoric cultural resources seem to be

d. Ringe, Brenda L., 1991, letter to C. F. Knutson, Archaeological Survey Coverage in the Vicinity of Test Area North (TAN) on the INEL, BLR-28-91, May 8, 1991.

concentrated in areas of some topographic variability, particularly along the edges of the lava, the playas, and Lake Terreton; atop the buttes; and along sand dunes and abandoned stream channels. Although they still occur occasionally, cultural resources are less likely to be found in the flat and featureless expanses of the Lake Terreton Basin and Birch Creek alluvial fan. An archeological survey conducted in 1986 discovered no significant resources in the immediate vicinity of TAN (Reed et al., 1986). To ensure that no resources are inadvertently disturbed during INEL activities, all ground disturbance in the TAN area will be preceded by archaeological surveys.

2.2 History of TAN Operations

TAN is located in the northern portion of the INEL, approximately 15 mi west of the town of Terreton (see Figure 2-2). The location of TAN allows it to operate and function with minimal contact with other working areas of the INEL. TAN was built between 1954 and 1961 to support the Aircraft Nuclear Propulsion Program sponsored by the U.S. Air Force and the Atomic Energy Commission. TAN is operated under DOE contract by EG&G Idaho, with the exception of the Specific Manufacturing Capability Facility, which is operated by Babcock and Wilcox. Figure 2-3 (see page 2-4) is a generalized map of Test Area North and the various facilities at TAN.

TSF is centrally located within TAN and is an administrative, assembly, and maintenance area consisting of 31 buildings. Figure 2-22 provides identification numbers (addresses) assigned to various buildings at TSF (e.g., TAN-607). Various test facilities are located within a 1.6-mi radius of TSF. Other facilities at TAN are the Containment Test Facility (CTF) 1.5 mi west of TSF, the Water Reactor Research Test Facility (WRRTF) 1.6 mi southeast of TSF, and the deactivated Initial Engine Test (IET) Facility, 1.4 mi north of TSF.

One of the main structures at TSF is the TAN-602 building (Figure 2-22) which provides most of the office space for TAN and contains the area cafeteria. Other facilities associated with TSF are a warehouse, fire station, dispensary, and assorted buildings used for maintenance and crafts work. The major component of TSF is the three-story TAN-607 building complex.

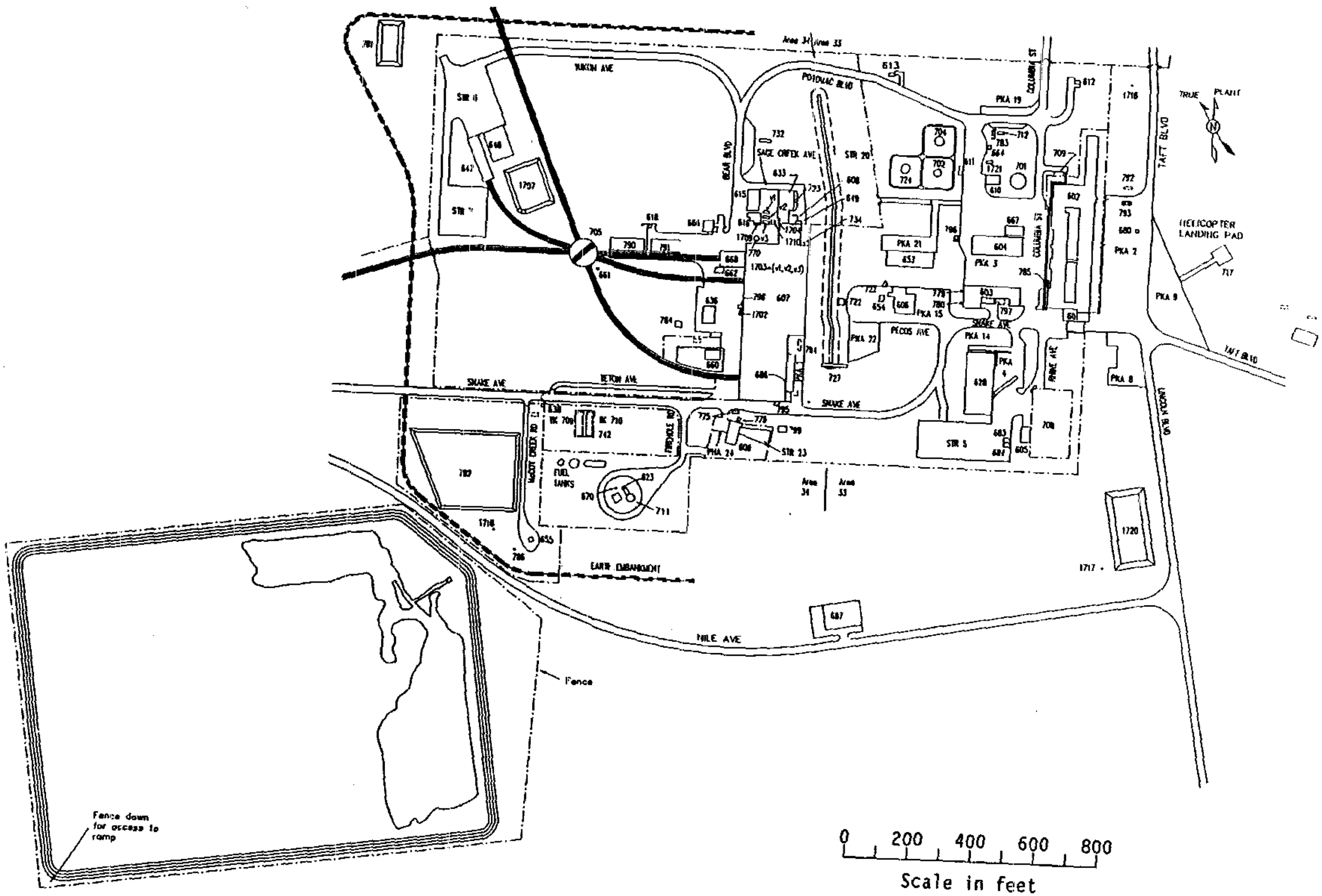


Figure 2-22. The Test Area North/Technical Support Facility plot plan.

The TAN-607 building complex can be separated into three parts (north, south, and middle) as follows:

- The north portion of the complex contains the Hot Cell Annex, Water Pit, Hot Shop, Hot Cell, and support offices. The Hot Cell Annex is used for examination of radioactive materials; the Water Pit is a large pool used for storage of radioactive materials; the Hot Shop is a large, shielded, high bay with equipment for remote handling of radioactive materials; and the Hot Cell is used for examination of fuel rods and small radioactive objects.

- The south portion of the complex was annexed in July 1984 for the Specific Manufacturing Capability project.

- The middle portion of the complex currently consists of the Process Experimental Pilot Plant and offices used by the plant's management personnel.

The Containment Test Facility was formerly the Loss-of-Fluid Test Facility (LOFT). The program for which the LOFT Facility was designed has recently been completed, and its nuclear reactor has been decommissioned. The Containment Test Facility utilized the containment facility to dismantle the mobile test assembly that contained the reactor vessel for the LOFT Facility.

The Water Reactor Research Test Facility includes the Semiscale Facility, the Blowdown Facility, and the Full Area Steady State Testing (FAST) Facility. The Semiscale project emulated, on a small scale, the principal features of a commercial nuclear reactor to predict what occurs during a loss-of-coolant accident. The Blowdown Facility provided a simulated environment of a pressurized water reactor to test instrument and component behavior. The FAST facility tested newly developed instrumentation for reliability and calibration. All of these nonnuclear facilities were used in support of the LOFT program and are deactivated.

The Initial Engine Test Facility included buildings and structures constructed for the Aircraft Nuclear Propulsion Program. Several programs have since operated at the facility, which has been deactivated since 1979.

2.2.1 Waste Generated by TAN/TSF Maintenance, Manufacturing, and Utility Operations

Facilities at TAN/TSF were screened to identify TAN/TSF shops, laboratories, and processes that may pose a potential for contamination. Table 2-6 provides the refined list of these facilities and also provides the hazardous waste constituents involved, the time frames in which the hazardous wastes were produced, and the methods used to dispose of the hazardous wastes. Detailed discussions of the activities associated with the shops, laboratories, or processes summarized in Table 2-6 including rough estimates on volumes generated, are available in the "RCRA Facility Investigation Work Plan for TAN Groundwater" (EG&G Idaho, 1988).

2.3 WASTE AREAS/WASTE CHARACTERISTICS

Seventy-one waste sites are identified in the Federal Facility Agreement/Consent Order (FFA/CO) and Action Plan for waste area group (WAG) 1 at TAN. Thirty-nine of these sites are located in the TSF area, 15 are located in the LOFT/SMC area, eight are located in the vicinity of the IET area, and nine have been identified in the WRRTF area. However, based on waste generation and disposal practices, historical records and personnel interviews, as well as environmental characterization data, only six of the sites could reasonably be expected to have received TCE and related volatile organics that could be sources for the groundwater contamination at TAN. Two additional sites, the TSF-03 and WRRTF-01 burn pits, were also evaluated because they received organic chemicals. However, after DOE, EPA, and IDHW evaluated the data on these two sites, they were not considered to be potential groundwater contaminant sources. Instead, they are being addressed in FY-92 under a separate FFA/CO investigation.

A discussion of each of the six sites considered to be, or previously considered to be, a source of groundwater contamination is presented below. Included in this discussion is a description of the intermediate-level waste disposal system located at TSF. A description of this unit is included here because it was an integral part of process operations tied to several of the potential source disposal sites. Figure 2-23 shows the location of the six sites and Table 2-7 represents a summary of the information presented for the TSF units.

Table 2-6. TAN/TSF--waste generation[a]

Shop Location	Function	Waste Stream	Time Frame	Treatment/Storage/Disposal[b]
TAN-604	Maintenance shop	Paint thinner and other chemicals	1956-1972	TSF injection well via sewage plant
			1972-1984	TSF disposal pond via sewage plant
			1984-Present	Offsite T/S/D
TAN-607	Chemical cleaning room (pipe laundry)	Corrosive liquids (acids and caustics, but drained separately)	1955-1972	TSF injection well
			1972-1974	TSF disposal pond
	Decontamination room	Corrosive liquids (acids and caustics, but drained separately)	1955-1975	TSF intermediate-level waste disposal system
			1975-1984	Idaho Chemical Processing Plant
		Oxalic acid solution	1955-1975	TSF intermediate-level waste disposal system
			1975-1984	Idaho Chemical Processing Plant
	Sandblast room	Potentially radioactive and EP Toxic spent sandblast media	1955-1984	Radioactive Waste Management Complex
	TAN Hot Cell	Decontamination solutions	--	--
		Corrosive waste water	1955-1969	TSF intermediate-level waste disposal system
		Corrosive chemicals	1970-1974	TSF intermediate-level waste disposal system
		Potassium hydroxide	1970-1974	TSF intermediate-level waste disposal system
		Potassium chromate	1970-1974	TSF intermediate-level waste disposal system
		Potassium permanganate	1970-1974	TSF intermediate-level waste disposal system

Table 2-6. (continued)

Shop Location	Function	Waste Streams	Time Frame	Treatment/Storage/Disposal
TAN-607	TAN Hot Cell	Oxalic acid	1970-1974	TSF intermediate-level waste disposal system
		Ammonium oxalate	1970-1974	TSF intermediate-level waste disposal system
	Photo lab and cold preparation lab	Corrosive photo developing solution	1955-1972	TSF injection well
TAN-633	Hot Cell Annex	Decontamination solutions and etching acid	1958-1972	TSF intermediate-level waste disposal system

a. Accurate disposal and usage records for these materials are not available, especially for early operations at TAN. Rough, unverified quantity estimates can be found in the RFI Work Plan (EG&G Idaho, 1988).

b. The intermediate level waste disposal system, including the TAN v-tanks and the PM-2A tanks, is discussed in Section 2.3.6.

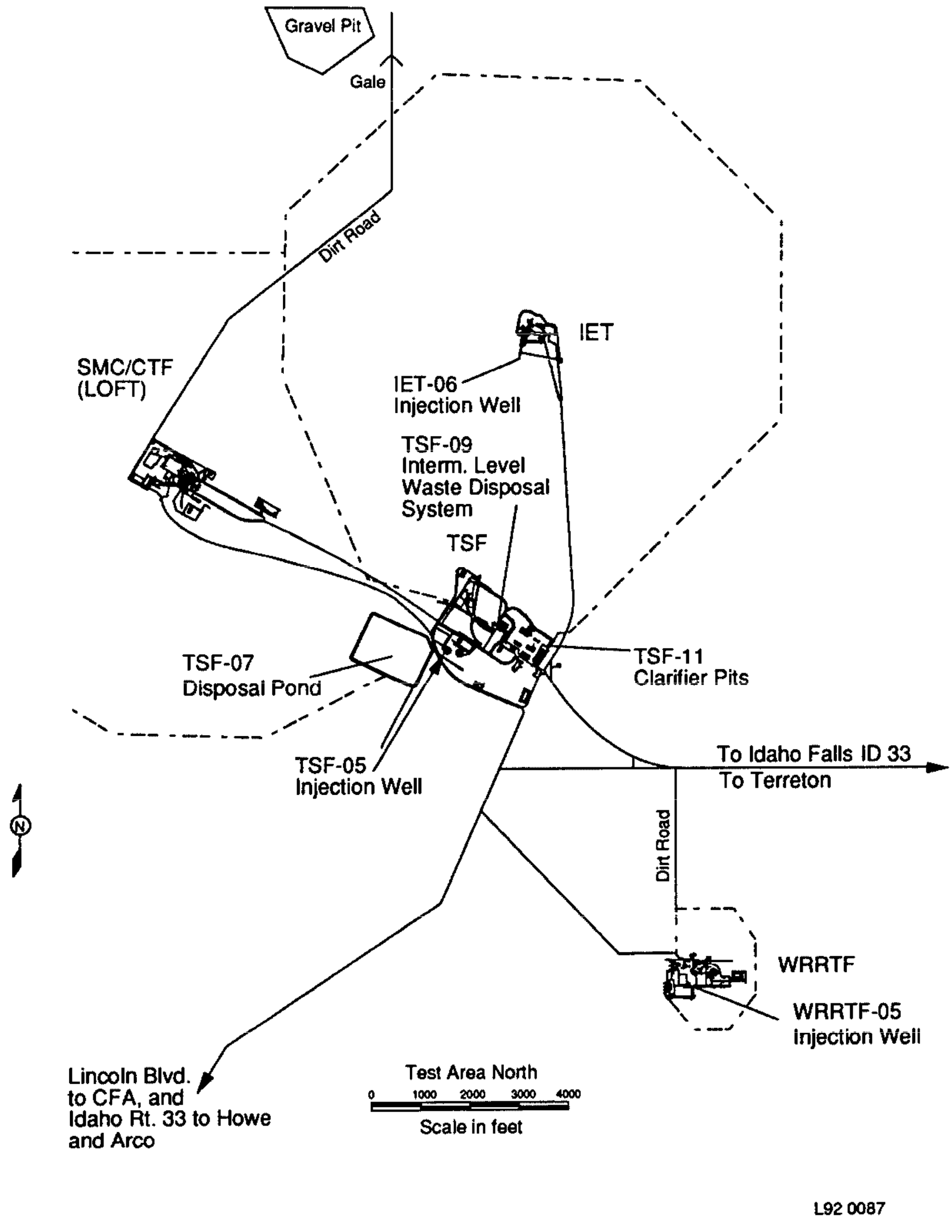


Figure 2-23. Locations of potential sources for groundwater contamination.

Table 2-7. TAN/TSF waste disposal sites[a,b]

Site	Site Name	Period of Operation	Area Size (yd^2)	Suspected Types of Wastes	Method of Operation	Closure Status	Surface Drainage
TAN-736/ TSF-07	TSF disposal pond	1972-Present	169,832	Corrosive waste water Ignitable wastes Chromium Lead Radionuclides	Discharge to common sump, then to open, unlined seepage pond	Active--Discharge of hazardous, nonradioactive chemicals has been eliminated	Pond is bermed against surface water intrusion
TAN-330/ TSF-05	TSF injection well	1955-1972	N/A	Corrosive waste water Ignitable wastes Chromium Lead Mercury Radionuclides Evaporator sludges[c]	Discharged with other waste water directly to deep disposal well with casing reaching to groundwater	Closed--Well capped and sealed	Wellhead is sealed against surface water intrusion
TAN-10A and TAN-10B/ TSF-26	Tanks T-709 and T-710 (PM-2A tanks)	1955-1975	287	Barium Chromium Lead Radionuclides Evaporator condensates	Discharge to underground tanks located within a concrete cradle	Closed--Free water has been removed from tanks and diatomaceous earth has been blown into remaining sludge	Hatch and pipe entrances are sealed against surface or subsurface drainage intrusion

a. Geological setting: The Snake River Plain Aquifer is about 207 ft from the surface, which is generally level. Subsurface consists of alternating layers of basalt and thin layers of sediment.

b. Hazardous wastes are no longer discharged to any of these sites. Only the TSF-07 disposal pond is still being used, but only for nonhazardous sanitary and process wastes from the TSF facilities.

c. The evaporator sludges are from the intermediate level waste disposal system as discussed in Section 2.3.6.

2.3.1 TSF Disposal Pond (TAN-736/TSF-07)

Construction of the TSF disposal pond and common sump (TAN-655) was started in 1971 and completed in late 1972. The pond was used in place of the TSF injection well, which was used until September 1972.

Low-level radioactive waste, cold process water, and treated sewage effluent are mixed in the common sump and lifted to the TSF disposal pond. The sump pump has a capacity of about 800 gal/min and is activated when the sump fills up to the float level. The effluent is then pumped to the pond.

The disposal pond is an unlined diked area encompassing approximately 35 acres. Taking into consideration volume losses from evaporation and infiltration, the pond's capacity is estimated at 33×10^6 gal/yr. Three trenches were excavated to construct 5-ft-high earthen dikes around the pond. A 1-ft-diameter galvanized steel pipe is the inlet to the pond from the common sump. The inlet pipe extends into the pond about 131 ft from the east corner of the pond.

The TSF disposal pond also receives effluent from the TSF trickling filter sewage treatment plant, boiler blowdown from the Service Building (TAN-603), and process wastes from the regeneration of water softeners. The TSF sewage plant (TAN-623/TSF-28) provides primary and secondary treatment for all TSF sanitary wastes and is designed to accommodate a flow of 60,000 gal/day. The TSF disposal pond receives treated sanitary sewage from the sewage plant. The plant's influent and effluent are routinely monitored for biochemical oxygen demand, dissolved oxygen, and settleable solids in addition to total organic carbon, chloride, fluoride, nitrate, phosphate, sulfate, and some heavy metals. The effluent is also monitored for pH. The results of these analyses are recorded in the IWMIS. The IWMIS is a computerized database that has been used at the Idaho National Engineering Laboratory (INEL) since 1971 and serves as the official record for all types of industrial (nonradiological) waste stored or disposed at the INEL. Department of Energy (DOE) contractors routinely report data to the IWMIS. The system provides routine and special reports for nonradiological airborne and liquid wastes, fuel oil consumption, water usage, and storage and disposal of solid wastes, as well as industrial wastes shipped off-site.

The specific hazardous wastes suspected to have reached the TSF disposal pond include corrosive liquids (acidic and basic solutions) from the TAN-607 pipe laundry and photo laboratory. Sampling of the pond influent has shown the waste water to be noncorrosive according to EPA hazardous waste definitions in 40 CFR 261.

The TSF disposal pond also receives low-level radioactive liquid effluent that can be discharged to a controlled surface pond per DOE Order 5400.5, "Radiation Protection of the Public and Environment". Concentrations of these effluents are published quarterly in Radioactive Waste Management Information System reports. From September 1972 through July 1985, the system reports that about 11 Ci have been discharged to the TSF disposal pond. Table 2-8 shows the number of released curies by nuclide as of July 31, 1985.

Table 2-8. Curies released to the TSF disposal pond (by nuclide) (September 1972 through July 1985)

Nuclide	Curies Released
Cobalt-58	4.063×10^{-2}
Cobalt-60	1.973×10^{-2}
Cesium-134	2.588×10^{-3}
Cesium-137	2.748×10^{-2}
Hafnium-181	2.046×10^{-3}
Molybdenum-90	1.228×10^{-2}
Ruthenium-106	1.915×10^{-5}
Strontium-89	3.358×10^{-3}
Strontium-90	3.923×10^{-2}
Tritium	1.072×10^{1}
Unidentified alpha	4.566×10^{-3}
Unidentified beta and gamma	2.124×10^{-1}
Yttrium-88	2.757×10^{-4}
Yttrium-90	3.923×10^{-2}
Total	11.124

The TSF disposal pond also received condensate from two evaporator systems connected with the intermediate-level waste disposal system (see Section 2.3.6 for detailed discussion). The first evaporator (1955-1972) was located north of TAN-607. The second evaporator (1972-1975) was located near the T-710A and T-710B tanks just north of the TAN sewer plant. There is no specific information on the chemical characteristics of the first evaporator condensate, but if it was similar to the condensate produced at the existing evaporator at the ICPP, then it can be assumed that it was corrosive (low pH). The concentrate from both evaporators went to the T-710A and T-710B tanks. Radionuclide and inorganic data on the sludge from these tanks is given in Section 2.3.6.

Records show that corrosive solutions mixed with rinse water from the evaporator went to the intermediate-level waste disposal system. The TSF disposal pond received corrosive waste as condensate from the evaporator (through May 1975) and also corrosive waste from the pipe laundry. It is also known that the intermediate-level waste disposal system received potassium chromate from 1970 through 1974 (see Table 2-6). It is not known how much of the chromium passed through the evaporator as condensate. The condensate may also have contained unknown quantities of lead originating from corrosive decontamination solutions being applied to lead shielding.

2.3.2 TSF Injection Well (TAN-330/TSF-05)

The TSF injection well (TAN-330/TSF-05) was drilled in 1953 to a depth of 305 ft to dispose of liquid effluent generated at TSF. It is located just south of TAN-655 (Figure 2-23). The well has a 12-in.-diameter casing to 305 ft and is perforated from 180-244 ft and 269-305 ft bls. The depth to groundwater is about 206 ft bls. The well was last used as a primary disposal site in September 1972, after which waste waters were diverted to the TSF disposal pond. Until the early 1980s, the well was used for overflow from the sump at TAN-655 in the event of a power failure, an equipment failure, or if equipment maintenance precluded discharge to the pond. There are no records as to whether or not such overflows actually occurred.

Discharges included treated sanitary sewage, process waste waters, and low-level radioactive waste streams. As with the disposal pond, the hazardous wastes include corrosive and ignitable wastes from shop operations and potentially corrosive and Toxic Characteristic Leach Procedure (TCLP) toxic condensate from the intermediate-level waste disposal system evaporator. The TCLP toxic heavy metals are suspect because of mercury contamination in the late 1950s and early 1960s, the use of a potassium chromate solution in decontamination activities after 1970, and the abundance of lead used for shielding materials that were decontaminated with corrosive solutions. The amounts of chromium, mercury, and lead that may have passed into the evaporator condensate (and to the well) are unknown. Personnel interviews indicate that concentrated material from the evaporator system was discharged to the TSF-05 injection well from the late 1950s to the early 1960s.

As mentioned, the TSF injection well also received low-level radioactive waste streams. The Radioactive Waste Management Information System contains curies by nuclide released to the TSF injection well for 1971 through August 1972. Records of the radioactivity released before 1971 are questionable, but published estimates put the amount released from 1959 through 1970 at about 45 Ci. However, no distribution by nuclides is available. Table 2-9 shows the nuclide distribution for 1971 and 1972 releases and the calculated distribution for 1959 to 1970 releases assuming the same distribution. Estimated total releases for 1959 through August 1972 are also provided in Table 2-9.

Historical records provide little definitive information on the types and volumes of organic wastes disposed to the injection well. However, based on existing characterization data for groundwater and sludge from the well (see Section 2.4 and Appendix B), disposal of fairly large quantities of organics and radionuclides are indicated. A preliminary estimate suggests that as much as 35,000 gal of TCE may have been disposed to the well; however, this number was based on personnel interviews and may be an over estimate. Estimates based on groundwater concentrations and the known extent of contamination suggest that several thousand gallons may be a lower limit although it should be noted that this estimate did not account for the potential presence of DNAPL near the injection well.

Table 2-9. Curies released to the TSF injection well (by nuclide) (1959 through August 1972)

Nuclide	Reported Curies Released (1971 and 1972)	Estimated Curies Released (1959-1970)	Estimated Total Curies Released
Cesium-134	4.597×10^{-3}	2.42×10^{-2}	2.88×10^{-2}
Cesium-137	2.180×10^{-2}	1.15×10^{-1}	1.37×10^{-1}
Strontium-90	8.642×10^{-3}	4.56×10^{-2}	5.42×10^{-2}
Tritium	8.481	44.72	53.20
Unidentified alpha	1.044×10^{-3}	5.51×10^{-3}	6.55×10^{-3}
Unidentified beta and gamma	8.530×10^{-3}	4.50×10^{-2}	5.35×10^{-2}
Yttrium-90	8.642×10^{-3}	4.56×10^{-2}	5.42×10^{-2}
Total	8.534	45	53.53

2.3.3 Three TSF Clarifier Pits East of TAN-604 (TSF-11)

The three TSF clarifier pits are located east of TAN-604. They are concrete rectangular settling basins and have a total capacity of 3,158 gal (Figure 2-23). In these clarifiers, a flow with relatively high suspended solids was introduced at one end of Pit 1. The solids settled along the length of flow, which included Pits 2 and 3 in series. A flow with relatively low suspended solids exited through trough-type overflow weirs at the end of Pit 3, to the TAN sewage treatment plant and ultimately, to either the TSF-05 injection well (until 1972) or the TSF-07 disposal pond (after 1972).

According to personnel interviews, the pits were used for settling contaminated waste water from the Maintenance and Paint Shops at TAN-604 from 1957 to 1985. The suspected contaminants may have includes an unknown volume of chemicals from cleaners, paint thinners, and paint strippers. The pits are active, but have received no hazardous materials since 1985. The pits contain approximately 7.5 to 11 in. of cohesive sludge at the bottom with 1 to 2 in. of settled waste water on top. Sludge samples analyzed in May 1988 and June 1989 contained acetone, methylene chloride, methyl ethyl ketone, toluene, and xylene. The data are summarized in Table 2-10 and the May 1988 data are given in Appendix K.

According to personnel interviews conducted during the RCRA Facility Investigation, the painting and cleaning chemicals were kept in a 5-gal can and used until the chemical was not longer effective. The can would then be poured down the TAN-604 drain into TSF-11 clarifier pits and emptied (according to the RFI Work Plan) only a few times each year.

The TSF-11 clarifier pits were also connected to the TAN sewer plant which is connected to the TSF-05 injection well and the TSF-07 disposal pond. However, the quantity of painting and cleaning chemicals that could have actually reached the injection well or the disposal pond cannot be estimated. Large amounts of these chemicals would have been lost to bacterial degradation in the pipes and sewer plant, and to volatilization in the trickling filter at the sewer plant or in the pits themselves. No organic samples were taken from the sewer plant during the time the clarifier pits could have been used

Table 2-10. Sampling data for the TSF-11 clarifier pits

Contaminant	Concentration (ug/l)	Data Collected[a]
Acetone	13,124 (J)	6/89
Dichlorodifluroethylene	3,867 (J)	6/89
1,1 Dichloroethylene	6	5/88
Ethylbenzene	15	5/88
Methylene chloride	13,118	6/89
Methyl ethyl ketone	29,677 (J)	6/89
4-methylphenol	129 (J)	6/89
Phenol	14 (J)	6/89
Phthalates	500	5/88
Toluene	16	5/88
1,1,1 trichloroethane	7	5/88
Xylene	2,290 (J)	6/89

Note: (J)—data flag that means the chemical was probably in the sample, but the concentration level is an estimate.

a. May 1988 data are given in Appendix K and were given in the RFI workplan (November 1988). The June 1989 data were taken under the INEL Underground Storage Tank program.

for chemical waste disposal, so no information exists that would show the sewer plant effluent ever had significant levels of organic contamination.

The five key organic chemicals found in the pits are not major constituents in either the TSF injection well or the TSF disposal pond. These chemicals also have other sources at TAN and in the analytical laboratories. Therefore, at this time, there is no way to show that the chemicals in the pits actually reached either the injection well or the disposal pond. Similarly, there is no way to show that the same types of chemicals in the well or pond came from the pits.

2.3.4 IET Injection Well TAN-332 (IET-06)

The IET injection well, also known as the IET disposal well or IET-06, was drilled in 1953 to a depth of 329 ft to dispose of effluent generated at IET during its period of operation. The well is located at IET, north of TSF (see Figure 2-23). Although little information is available that describes the well, it is assumed that the well received process waste water (i.e., from TAN-620 floor drains) and probably sanitary sewage, as a minimum. These process waters may have included acidic ion exchange regenerants, waste diesel fuels and boiler blowdown from TAN-620 boilers, small amounts of engine coolant or fuels from the nuclear engine tests, and possibly wastes from a photo lab in TAN-620. Several years of sampling (1988-1990) have not detected any significant levels of contamination in the well as a result of these activities (see Section 2.4.2.3).

2.3.5 WRRTF Injection Well (WRRTF-05)

As with the IET injection well, little information is available for the WRRTF injection well (WRRTF-05). The well is located south of WRRTF (see Figure 2-23). Based on facility operations, the well is thought to have received cooling water effluent, sanitary waste, as well as materials from laboratories and process drains. There are also indications that hydrazine from facility operations was disposed to the well. The WRRTF injection well is currently grouted up and inaccessible.

2.3.6 TSF Intermediate-Level Waste Disposal System (TSF-09)

This radioactive liquid waste system collected, processed, and provided interim storage capacity for all intermediate-level radioactive liquid waste generated at TSF. Drains and sumps located in areas with a high potential for contamination were piped to a waste transfer facility (TAN-616). There, the radioactive liquid waste was collected in one of three underground 10,000-gal stainless-steel collection tanks (V-1, V-2, or V-3). These tanks are located immediately northeast of TAN-616 between TAN-615 and TAN-633 (see Figures 2-22 and 23). From that point on, the process for handling these intermediate-level wastes has changed over time. Figure 2-24 depicts flowcharts for the three different systems that have been used to process this waste.

From 1955 to 1972, liquid waste from the 10,000-gal collection tanks was concentrated by an evaporator, and the concentrate was transferred to tanks T-710A and T-710B (also known as the PM-2A storage tanks) for long-term storage. (T-710A and T-710B are both 50,000-gal underground tanks located south of the railroad track turntable and Snake Avenue, as shown in Figure 2-22.) The condensate from the evaporator was then sent to the TSF injection well.

In the late 1950s and early 19602, according to interviews, the evaporator concentrate in the bottom of the T-710A and T-710B tanks was pumped out by TAN facilities personnel and put into the injection well. No samples were taken of this material during this time. It is possible that the majority of the sludge taken from the injection well in 1990 came from these tanks, but there is no information to confirm this assumption. Inorganic and radionuclide data on the sludge (from 1981) are given in Tables 2-11 and 2-12 and are discussed in greater detail at the end of this section. No samples were taken for organics because there were no specific requirements for organic analyses at that time.

In 1972, the process was modified so that the original evaporator downstream of the V-1, V-2, and V-3 tanks was removed and a new evaporator installed in the T-710A and T-710B tank area. The intermediate-level waste

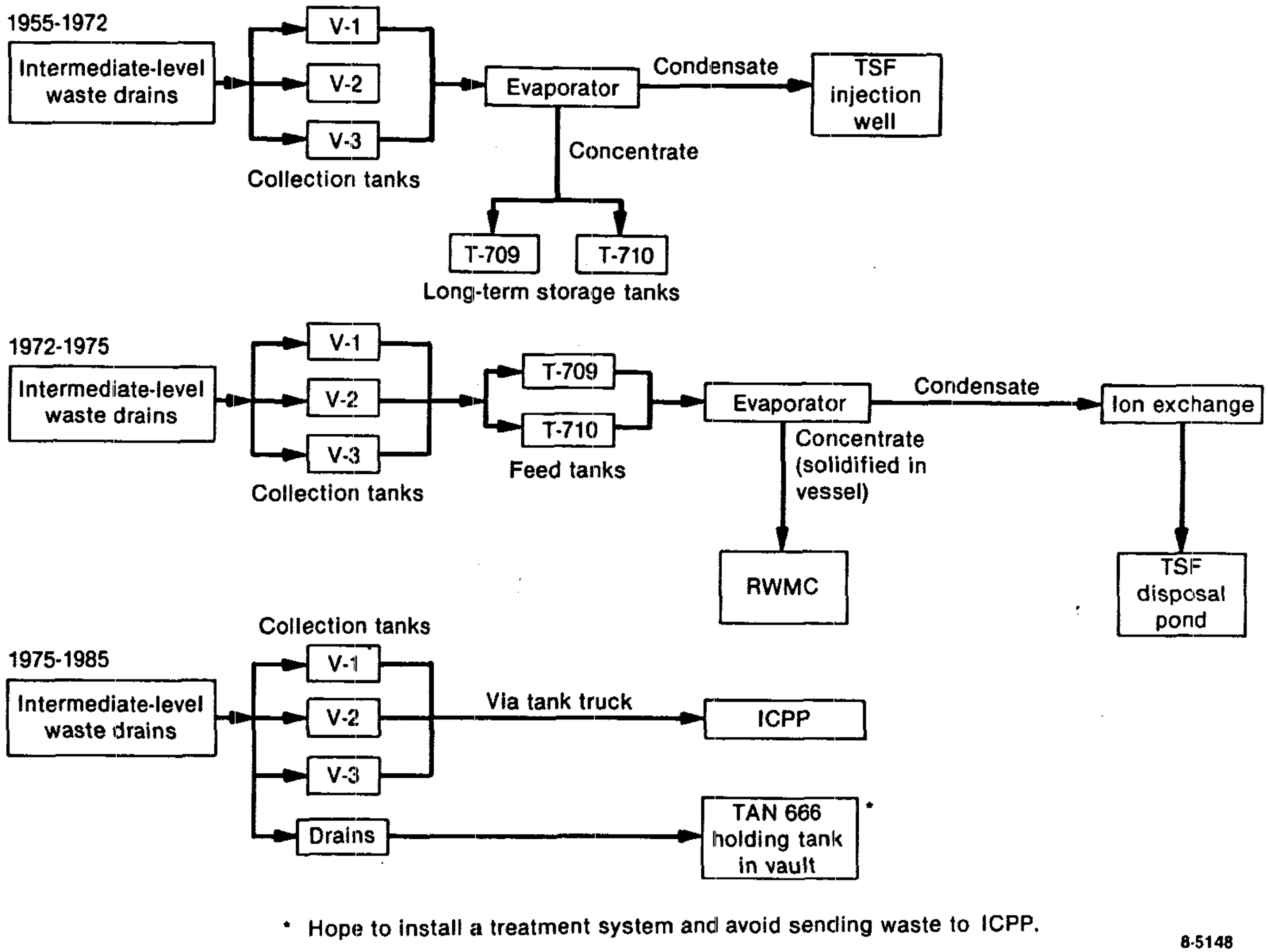


Figure 2-24. TSF flowcharts of the intermediate-level liquid waste system.

Table 2-11. Chemical analysis of sludge in TSF tanks T-710A and T710-B

	Results (g/L)	
Parameter	T-710A Sludge	T-710B Sludge
Volume in liters	1374.0	7033.0
Undissolved solids connc.	262.0	448.0
Aluminum	5.2	3.6
Barium	0.5	4.5
Calcium	5.2	9.0
Chromium	1.8	3.6
Copper	0.005	0.013
Iron	15.7	17.9
Lead	0.16	0.31
Magnesium	2.6	4.5
Manganese	1.8	2.2
Nickel	0.03	0.09
Phosphorus	7.9	49.3
Silicon	86.5	85.1
Tin	0.13	0.04
Titanium	0.08	0.13
Zinc	0.79	0.90
Zirconium	0.03	0.04

Table 2-12. Curies contained in tank T-710A and T-710B sludges (as of 1981 sampling)

Radionuclide	Tank T-710A Concentration (Ci/L)	Tank T-710A Total Curies	Tank T-710B Concentration (Ci/L)	Tank T-710B Total Curies	Total Curies (both Tanks)
(AM) Americium	1.12×10^{-7}	1.54×10^{-4}	8.14×10^{-7}	5.72×10^{-3}	5.88×10^{-3}
(CO) Cobalt-60	3.05×10^{-4}	4.19×10^{-1}	9.70×10^{-5}	6.82×10^{-1}	1.10×10^{0}
(Cs) Cesium-134	5.87×10^{-6}	8.07×10^{-3}	2.10×10^{-6}	1.48×10^{-2}	2.29×10^{-2}
(Cs) Cesium-137	3.37×10^{-3}	4.63×10^{0}	--	--	4.63×10^{0}
(Eu) Europium-154	1.36×10^{-5}	1.87×10^{-2}	--	--	1.87×10^{-2}
(Np) Neptunium-237	1.18×10^{-4}	1.62×10^{-1}	1.08×10^{-4}	7.60×10^{-1}	9.22×10^{-1}
(Sr) Strontium-total	2.65×10^{-3}	3.64×10^{0}	4.27×10^{-3}	3.00×10^{-1}	3.36×10^{1}
(Pu) Plutonium	2.17×10^{-6}	2.98×10^{-3}	2.00×10^{-6}	1.41×10^{-2}	1.71×10^{-2}
Total	--	8.88×10^{0}	--	3.15×10^{1}	4.03×10^{1}

was then collected in the V-1, V-2, and V-3 tanks and pumped directly to T-710A and T-710B, which served as feed tanks for a subsequent stainless-steel evaporator. The liquids and entrained radioactive solids were separated in the evaporator; the solids remained in the evaporator vessel, which provided interim storage during processing and also served as the long-term storage container. When filled to capacity (about 20 tons), the semisolid radioactive waste was solidified by evaporation, and the container was transferred to the Radioactive Waste Management Complex for disposal. Distillate from the evaporator flowed to the condenser and then to a condensate storage tank. The condensate was passed through a fabrication ion-exchange column for further removal of radioactive ions. Effluent from the ion exchanger was combined with other TSF low-level radioactive liquid waste before being discharged into the TSF disposal pond. The newer evaporator system was shut down in 1975. Because of operational difficulties and spillage, the system was never put into full operation. Since 1975, the TSF intermediate-level waste has been collected in the V-1, V-2, and V-3 tanks and then transferred to tank trucks for shipment to the ICPP.

The TSF intermediate-level waste disposal system was designed to receive and treat waste too radioactively contaminated to be discharged to the TSF disposal pond. Any hazardous chemicals reaching this system were incidental to the processing of radioactive materials. The system potentially received corrosive materials from decontamination activities and, in some instances, heavy metals, particularly mercury, during its extensive usage in the late 1950s and early 1960s. Also, small quantities of potassium chromate were used in decontamination solutions from 1970 to 1974.

Records are unavailable to show which hazardous chemicals may have passed through the evaporator (when it was in use) and into the condensate stream. It can be assumed that the concentrate from the evaporator system may have contained small quantities of hazardous chemicals, but these concentrates were eventually solidified before disposal at the Radioactive Waste Management Complex. The hazardous chemicals identified so far, especially the metals, should pose little problem in a solidified form.

From the 1960s to 1975, the majority of the radioactive material discharged to this system was eventually disposed of at the Radioactive Waste

Management Complex. The lesser amounts of radioactivity that were discharged in the condensate to either the TSF disposal pond or injection well were included in the quantities discussed earlier. The radioactivity in the sludges discharged to the injection well is not believed to have been included in the RWMIS system. Since mid-1975, all waste water reaching this system has been trucked to the ICPP for processing and is not a concern for TAN.

The sludge in Tanks T-710A and T-710B has been sampled and characterized. The results of 1981 chemical analyses for metals are provided in Table 2-11. These results are based on a single grab sample, and the sludge may not be homogeneous. However, the sample does give an idea of the contents of the sludge and shows that barium, chromium, and lead (all toxic metals) are present.

The 1981 sludge samples were also analyzed for radionuclides. The results of that sampling are provided in Table 2-12, along with the total curies in the tanks as of 1981. Although the sludge may have been heterogeneous, it should be noted that the figures for total curies are based upon a homogeneous sludge. However, the figures do allow an estimate of the activity in the tanks.

2.4 EXISTING CHARACTERIZATION DATA

During routine water sampling by EG&G Idaho in April 1987, a sample collected from the TSF production well TAN-1 (also referred to as TAN-612) indicated possible trichloroethylene (TCE) contamination of the groundwater. Wells TAN-1 and TAN-2 (TAN-613) were resampled in both September and November 1987. Resampling efforts confirmed the presence of TCE in TAN-1 at concentrations between 4.4 and 8 ppb and TCE concentrations of 2 to 3 ppb in TAN-2. The detection of organic contaminants at the wellhead from these two TSF production wells represented a confirmed release to a critical receptor, since these wells supply the water for personnel at TSF.

As a result of this confirmed release, a Resource Conservation and Recovery Act (RCRA) Corrective Action Program was developed to address groundwater contamination at TAN. One of the first actions initiated was the

1989 installation of an air sparging system to the water supply system to reduce contaminant concentrations below safe drinking water levels. A RCRA Facility Investigation (RFI) work plan was also generated (EG&G Idaho, 1988), and RFI activities were conducted in FY-89 and FY-90. In FY-91, the RFI was replaced by an RI/FS due to the INEL change from the COCA to the FFA/CO. The following sections discuss the possible sources of contamination (as identified in Section 2.3) and existing characterization data. Both pre-RFI and RFI activities were carried out to characterize some of these possible contaminant sources and to ascertain the extent of understanding with respect to the groundwater contamination problem at TAN.

2.4.1 Possible Sources

Based on past disposal practices, historical records, and personnel interviews, and on waste stream/generation information (Section 2.3), three solid waste management units (SWMUs) at TSF could have received TCE, tetrachloroethylene (PCE) or other organic chemicals, and were therefore targeted for further investigation as part of the RFI activities. These three SWMUs are units TSF-07 (TSF disposal pond), TSF-05 (TSF injection well), and TSF-11 (TSF clarifier pits). Subsequent to the RFI, both the IET injection well and the WRRTF injection well have been identified as possible sources of groundwater contamination, in part because each provides a direct route for contaminants to the aquifer.

2.4.2 Characterization of Possible Sources

Table 2-13 represents a summary of sampling activities carried out prior to final issuance of the TAN Groundwater RFI Work Plan (EG&G Idaho, 1988) as well as the sampling conducted since that time. The following discussions focus on characterization data for volatile organics, specifically TCE, since TCE represents the contaminant of greatest concern and is also the most widely distributed contaminant.

2.4.2.1 Surface Sources. Analytical results from sediment samples from potential surface sources (TSF-07 and TSF-11) suggest that these sites are not contributing volatile organic contaminants to the groundwater system at TAN.

Table 2-13. Pre-RFI and RFI characterization tasks

Task	Date	Comments
Pre-RFI		
• TSF clarifier pit sludge sampling	December 1987	Samples analyzed for volatile and semivolatile organics, pesticide organics, and inorganics (see EG&G Idaho, 1988) and Appendix K.
• TSF injection well	--	See RFI tasks
• TSF disposal pond	--	See RFI tasks
• Soil gas survey	May 1988	Results inconclusive with respect to identifying a groundwater contaminant plume
RFI		
• Groundwater samples collected from wells in the vicinity of the TSF-05 injection well	March 1989	Validated analytical results indicated elevated TCE concentrations in the groundwater (Appendix G)
• Augering and split spoon sampling of surficial sediments in areas with elevated TCE soil gas readings	July-Nov 1989	Depth profile sampling for Appendix IX constituents, volatile organic compounds (VOCs), metals, and radionuclides from the TSF disposal pond (5 bore holes, 3 perched water piezometers), and at 2 areas inside TSF (see Appendix A)
• Groundwater sampling of 19 monitoring and observation wells	Oct 1989-Jan 1990	Samples analyzed for VOCs, metals, alkalinity, anions, and radionuclides (see Appendix C)
• Removal of 55 ft of sediment/sludge from the TSF injection well	Jan-Feb 1990	Analysis of sediment/sludge for VOCs, metals, and radionuclides (see Appendix B)
• Groundwater sampling of 29 monitoring and observation wells	Oct-Dec 1990	Samples analyzed for VOCs, metals alkalinity, anions, and radionuclides (see Appendix D)

Extensive depth profile sampling in the TSF disposal pond (TSF-07) was conducted in November 1989 because this site was the terminal disposal site for several waste streams or processes that used TCE. Tabulated validated analytical results from this sampling effort are provided in Appendix A. Although organic contaminants were not detected at elevated levels in either the sediments or perched water beneath the pond, the presence of metals and radionuclides was noted. Further investigation of the TSF disposal pond will not be carried out under the TAN Groundwater remedial investigation/feasibility study (RI/FS) due to the fact that available data indicate that organic constituents are not a concern in the pond.

Preliminary results from the analysis of sediment samples from the TSF clarifier pits also suggest that this site is not a source of TCE to the groundwater system. The analytical results for the samples collected at this site can be found in EG&G Idaho (1988) and Appendix K of this work plan.

2.4.2.2 TSF-05 Injection Well. Based on the results of groundwater quality analyses from the injection well, as well as from analytical and radiological analysis of sediment/sludge removed from the well in 1990, the TSF-05 injection well is the primary source of groundwater contaminants at TAN. Elevated concentrations of TCE and other volatile organics have been detected as a result of several sampling efforts by the USGS and EG&G Idaho since 1988. Groundwater quality data from these past sampling events show TCE concentrations at the well head ranging from 16 to 30 mg/L. Tetrachloroethylene (PCE) was also detected at concentrations above drinking water standards.

During January and February 1990, 55 linear ft of sediment/sludge (from well depths between 250 and 305 ft) was removed from inside the well casing. Analysis of this material indicated very high (~2%) TCE concentrations in the sludge, as well as elevated concentrations of radiological and metal constituents such as tritium and cesium. Table 2-14 presents a summary of contaminant concentrations in the sludge (also see Appendix B). The temporal effects of this initial sludge removal effort on groundwater quality cannot be fully evaluated with existing data. As can be seen in the following figures, both increases and decreases in TCE concentrations were found in the groundwater monitoring wells between FY-89 and FY-90.

Table 2-14. Contaminant concentration in TSF-05 injection well sludge

Substance	Environmental Concentration (with units)	In Sample (soil, water, etc.)
Methylene chloride	290 ppm	In sludge
1,2-dichloroethene	410 ppm	In sludge
Trichloroethylene	30,000 ppm 35 ppm	In sludge In water
Tetrachloroethylene	2,800 ppm	In sludge
2-butanone (MEK)	1,800 ppm	In sludge
Cobalt-60	812 picocuries/gm	In sludge
Cesium-137	2,540 picocuries/gm	In sludge
Europium-154	6.62 picocuries/gm	In sludge
Americium-241	23.6 picocuries/gm	In sludge
Tritium	1,000 picocuries/ml	In sludge
Plutonium-239	12.2 picocuries/gm	In sludge

2.4.2.3 IET and WRRTF-Injection Wells. Groundwater samples from the IET injection well have been collected annually since 1987. In 1987, TCE was detected in this well at 1.3 μg/L. Since that time, TCE has not been detected. Although available data suggest that the IET injection well is not a source of contaminants to the groundwater system, groundwater samples will be collected and analyzed as part of this RI/FS because this well was a disposal site for IET and also because TCE was detected in 1987.

The WRRTF injection well has been grouted up and abandoned and is, therefore, inaccessible for characterization. However, a number of aquifer wells are located in the vicinity of the WRRTF injection well and have been periodically sampled. TCE has been detected in three of these wells (GIN-2 and GIN-4 in 1990, and ANP-8 in 1989 and 1990). Of the three, only ANP-8 has shown TCE above the MCL of 5 μg/L. Although existing data indicate that the TSF-05 injection well is probably the source of the TCE in the groundwater at

WRRTF, the WRRTF injection well as a source cannot be ruled out. However, several wells within 500 ft of the WRRTF injection well have shown only low levels of organic contamination, thus indicating that this injection well is not a major source of groundwater contamination. Additional characterization/ monitoring of the wells in the WRRTF area is planned under the RI/FS.

2.4.2.4 Regional Aquifer. Based on existing water quality data (pre-FY-89) and the results from groundwater sampling of wells in the vicinity of the injection well (March 1989, see Appendix G), eight groundwater monitoring wells were drilled and installed in late FY-89 and early FY-90. Subsequent to monitor well construction, a network of 19 new and existing monitoring, production, and observation wells within a radius of approximately 1 to 2 mi of the TSF injection well were sampled for analysis of VOCs, metals, radionuclides, alkalinity, and common anions (see Appendix C).

The distributions and concentrations of TCE, PCE, and DCE (total) in the groundwater, based on the FY-89 sampling event, are presented in Figures 2-25, 2-26, and 2-27, respectively. FY-89 groundwater quality data show that high concentrations of TCE (i.e., 660 μg/L - 28 mg/L) are present within 1/4 mi of the injection well. However, as shown in Figure 2-25, TCE concentrations exceeding 5 μg/L were detected as far away as WRRTF, 1-1/2 mi down-gradient from the injection well. Furthermore, as shown in Figure 2-25, TCE concentrations generally decrease with increasing distance from the injection well.

In late FY-90, nine additional groundwater monitoring wells were installed, and groundwater samples from a network of 29 new and existing wells were sampled in an effort to define the lateral extent of TCE contamination. The analytical results of this sampling effort are provided in Appendix D.

As shown in Figures 2-28, 2-29, and 2-30, the distributions and concentrations of TCE, PCE, and DCE (total) found in FY-90 are similar to those noted for FY-89. In each figure, the TSF-injection well concentration is from the FY-89 analysis. A graphical representation of the lateral extent of the TCE plume, based on an action level of $\geq$ 5 μg/L, is shown on Figure 2-31. As a result of FY-89 and FY-90 characterization activities, the

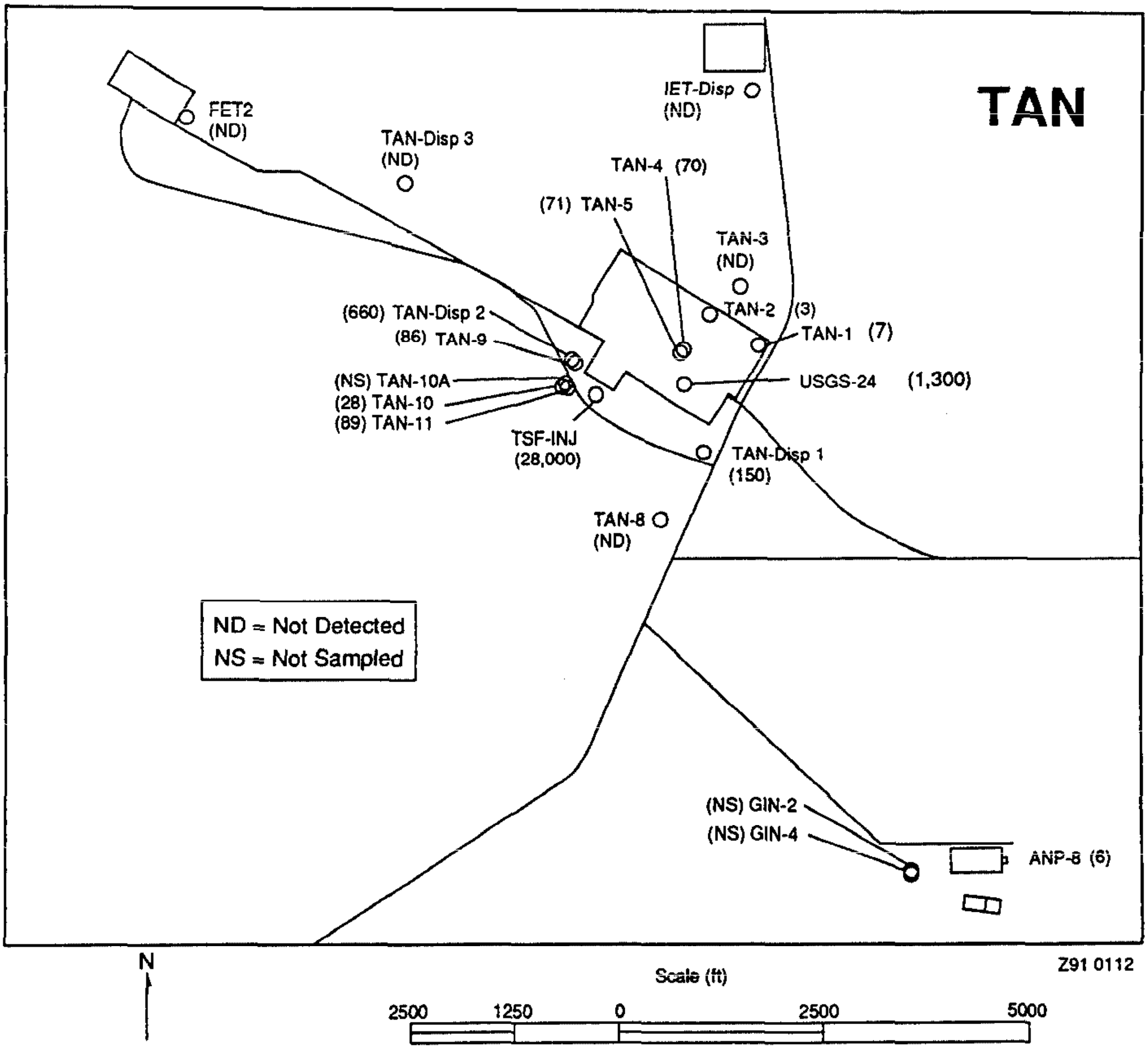


Figure 2-25. Distribution and concentration of TCE - FY-89 (concentrations shown in ( ) are in μg/L).

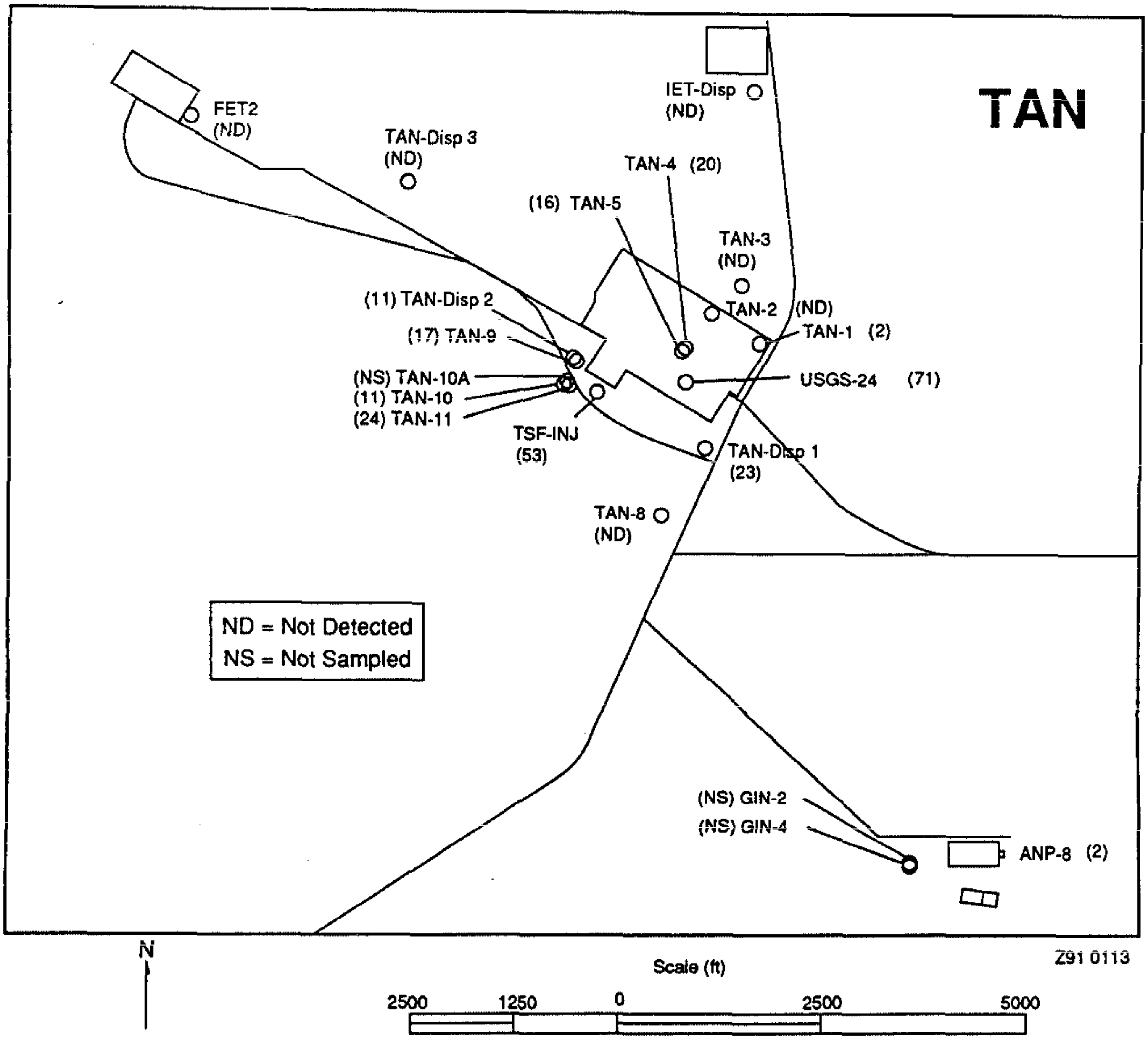


Figure 2-26. Distribution and concentration of PCE - FY-89 (concentrations shown in ( ) are in µg/L).

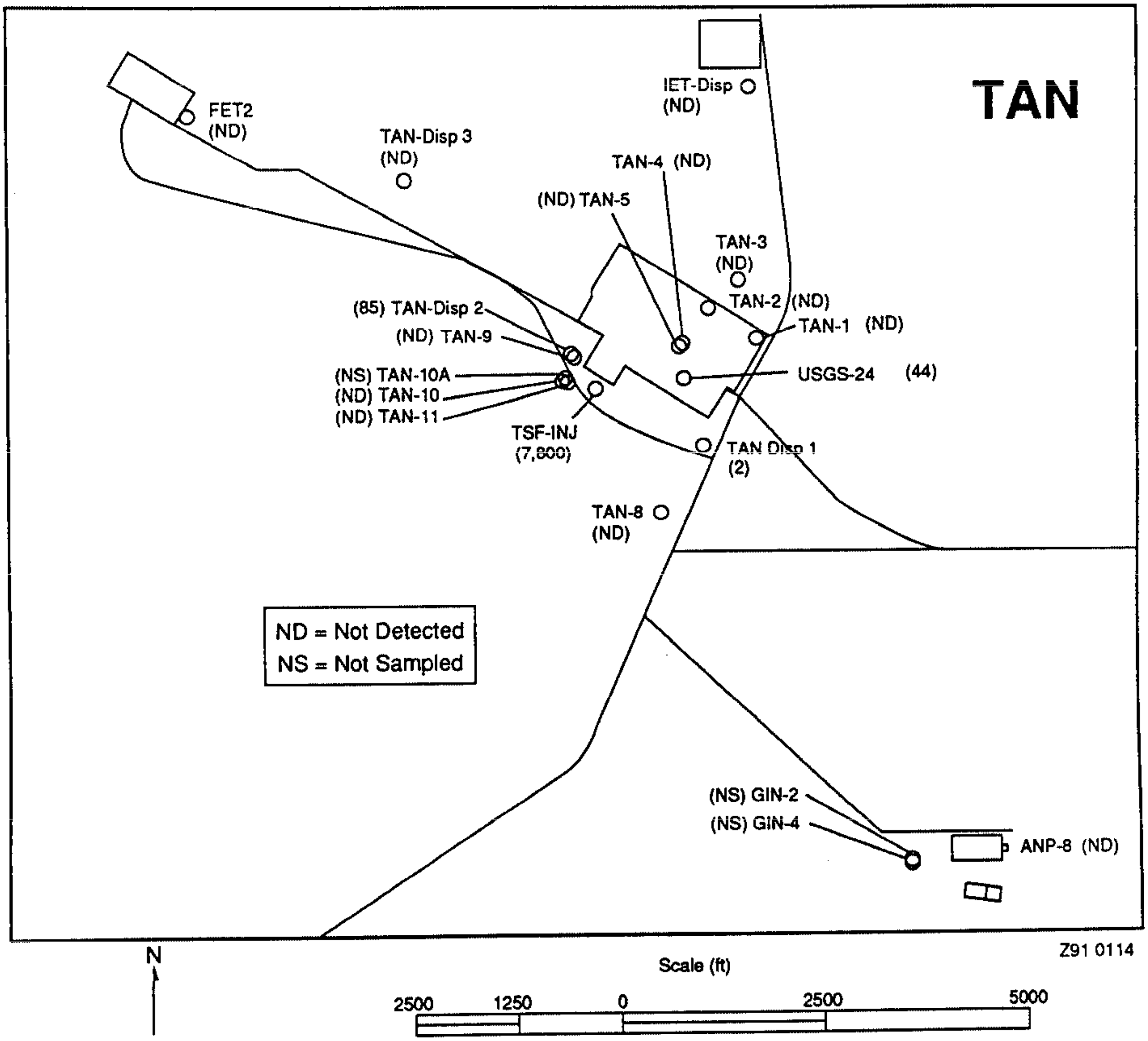


Figure 2-27. Distribution and concentration of total 1,2-DCE - FY-89 (concentrations shown in ( ) are in µg/L).

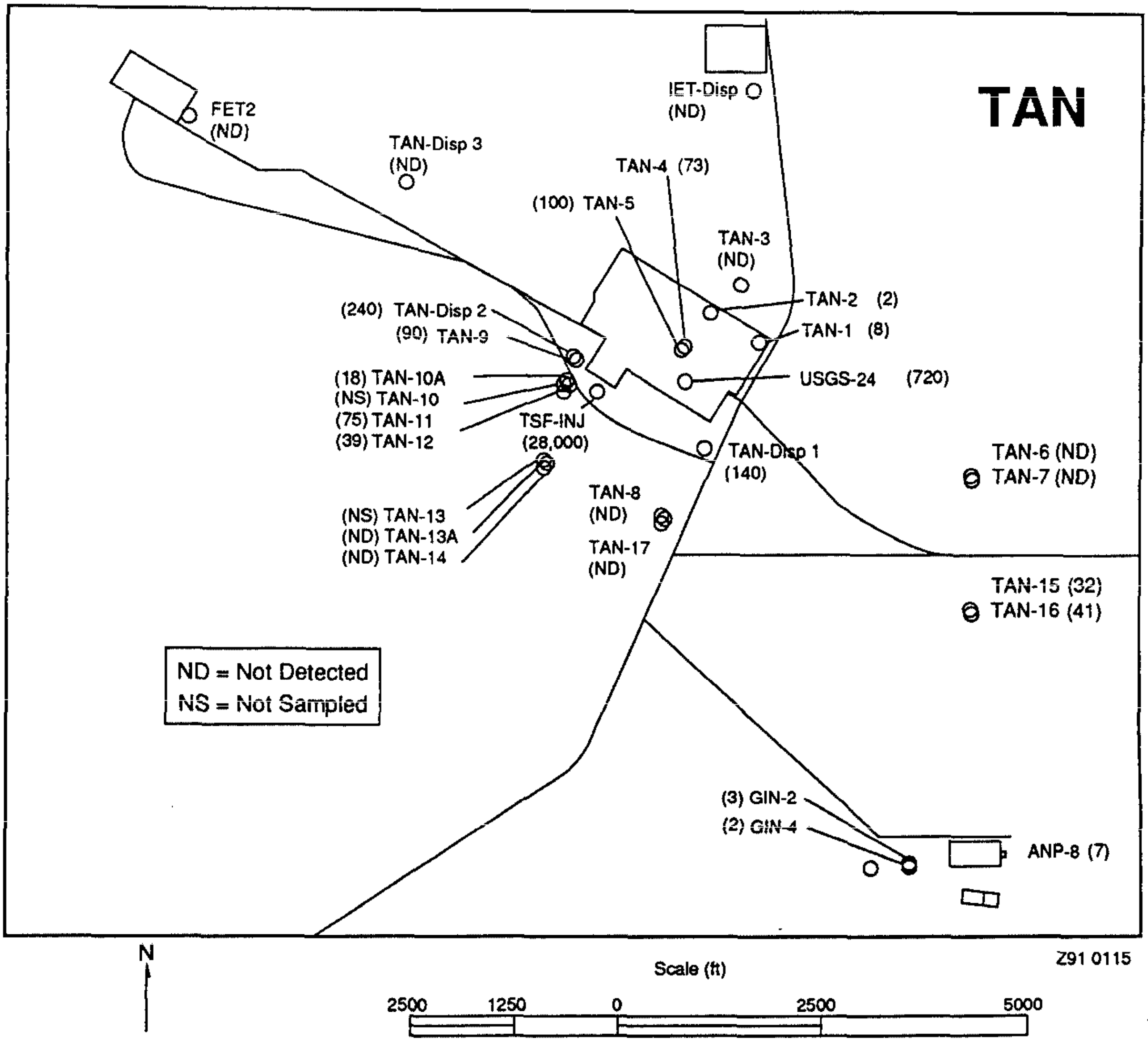


Figure 2-28. Distribution and concentration of TCE - FY-90 (concentrations shown in ( ) are in μg/L).

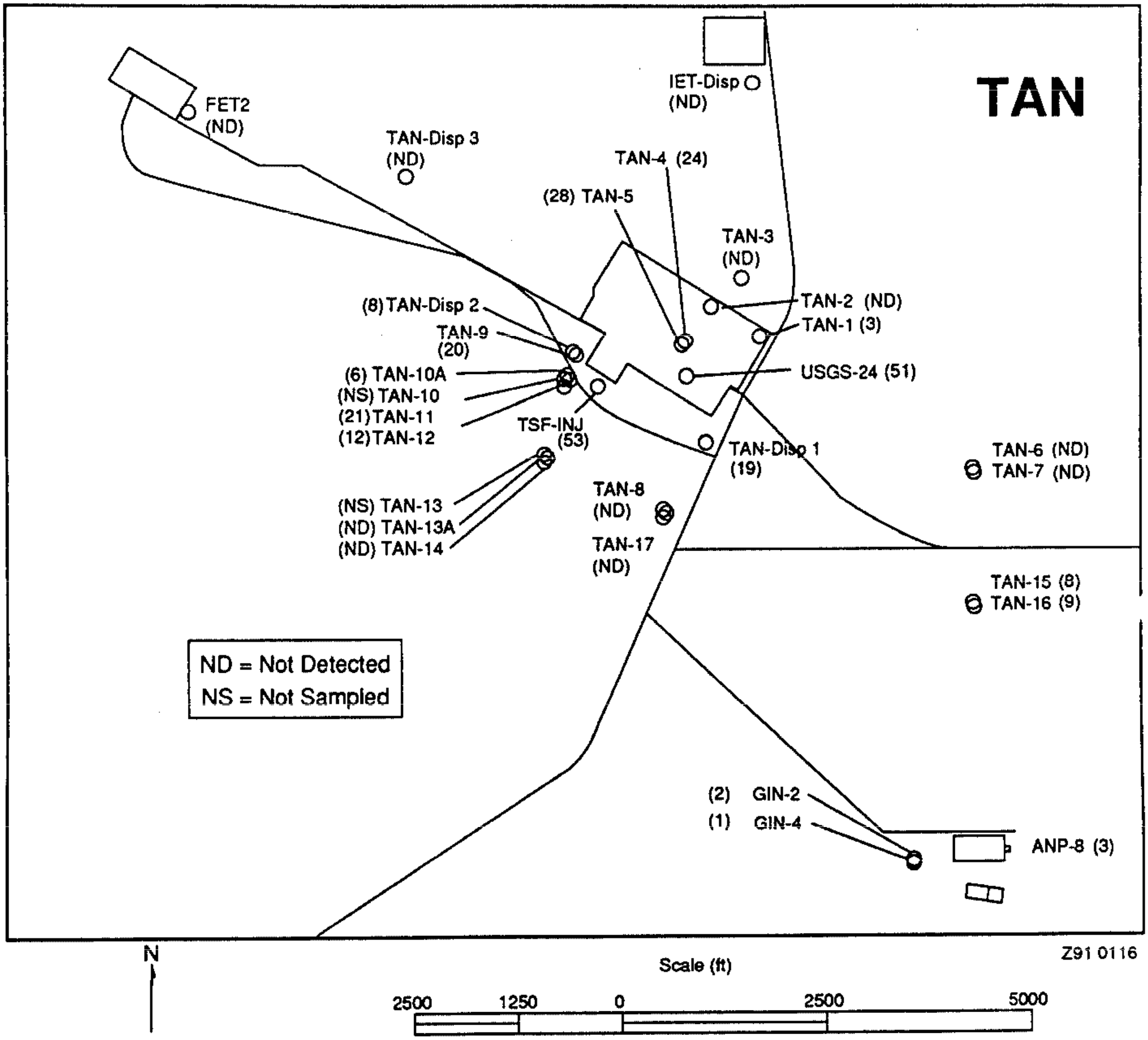


Figure 2-29. Distribution and concentration of PCE - FY-90 (concentrations shown in ( ) are in µg/L).

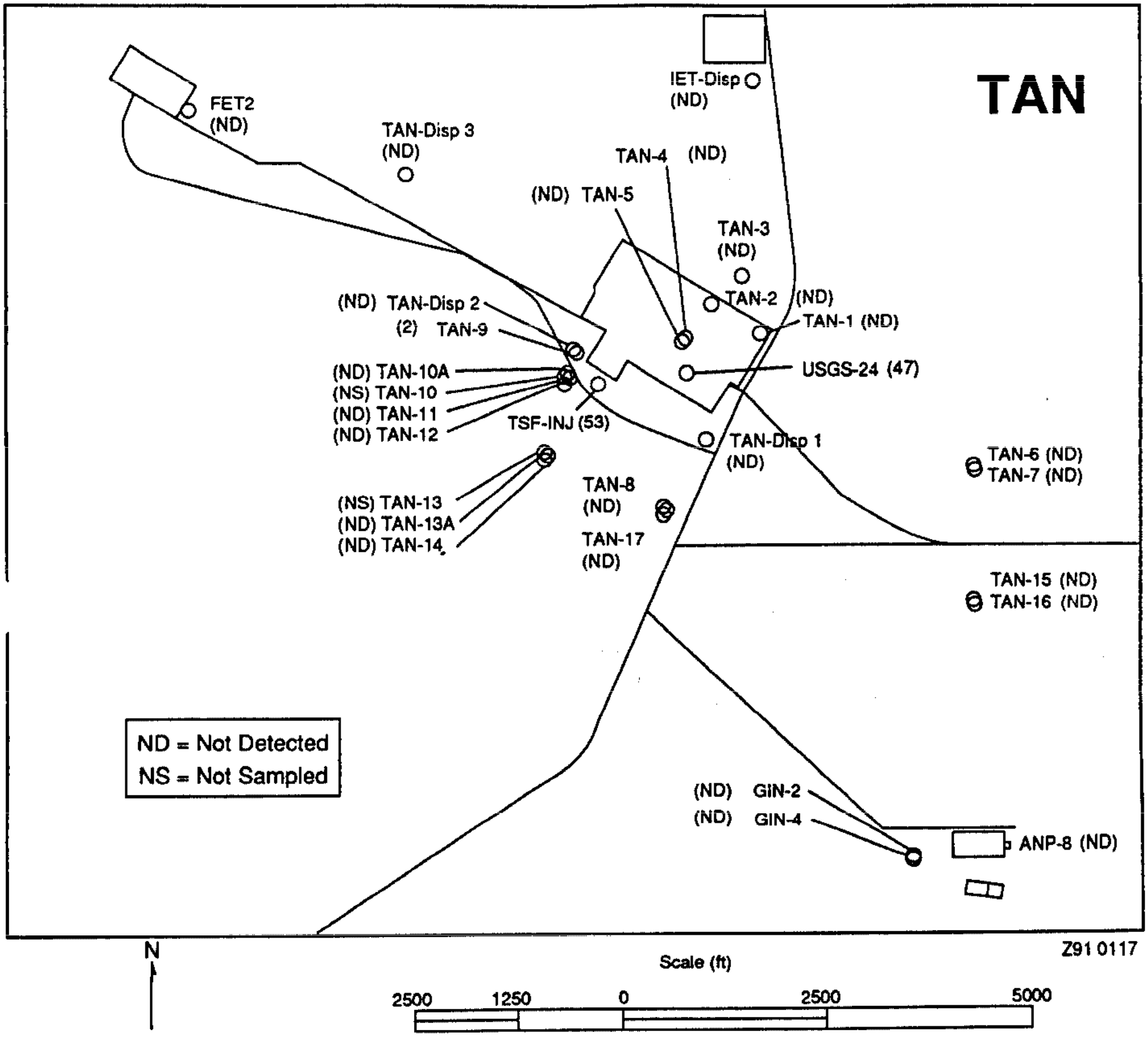


Figure 2-30. Distribution and concentration of total 1,2-DCE - FY-90 (concentrations shown in ( ) are in μg/L).

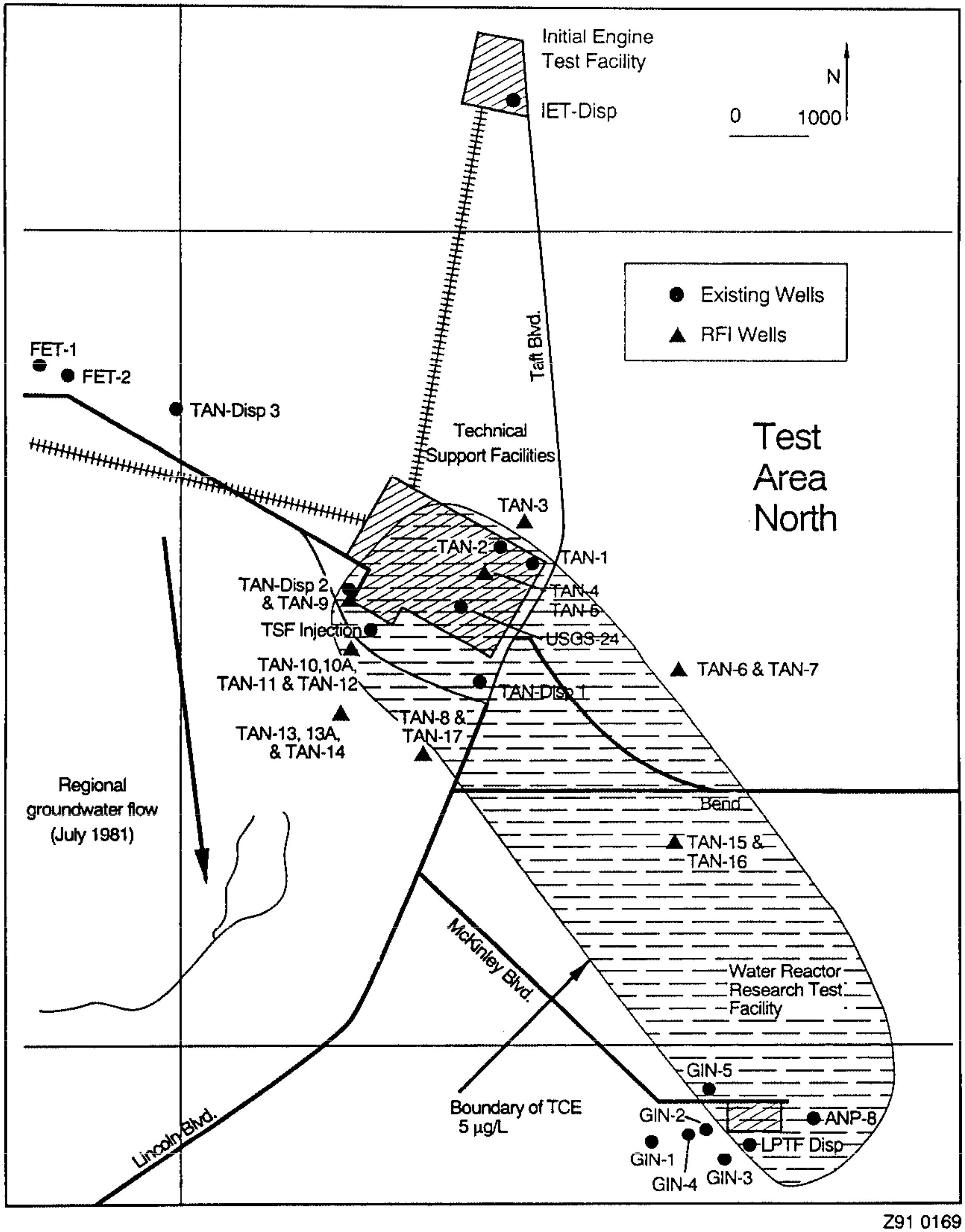


Figure 2-31. General configuration of the TCE plume - FY-90.

lateral extent of TCE contamination in the shallow groundwater (i.e., 200-400 ft bls) is fairly well known to the north, east and west. However, the vertical and southern extent of contamination has not been defined. Figures 2-31 and 2-32 illustrate the lack of definition for the southern and vertical extent of contamination respectively. The TSF injection well concentration for TCE shown in Figure 2-32 is also from FY-89 analysis.

2.4.2.4 Additional Characterization Data. In addition to sediment and groundwater analyses, a number of other tasks (i.e., drilling and installation of monitoring wells, slug tests of monitoring wells, monthly water level measurements) were completed during the RFI in FY-89 and FY-90. Construction details for all TAN area wells, including USGS wells, are included in Appendix E. Also presented in Appendix E are the available lithologic and geophysical logs for both USGS wells and wells installed as part of the TAN RFI. Additionally, water level measurements from available wells in the vicinity of TAN were collected on a monthly basis from December 1989 to December 1990. Water level data sheets and potentiometric maps are provided in Appendix F.

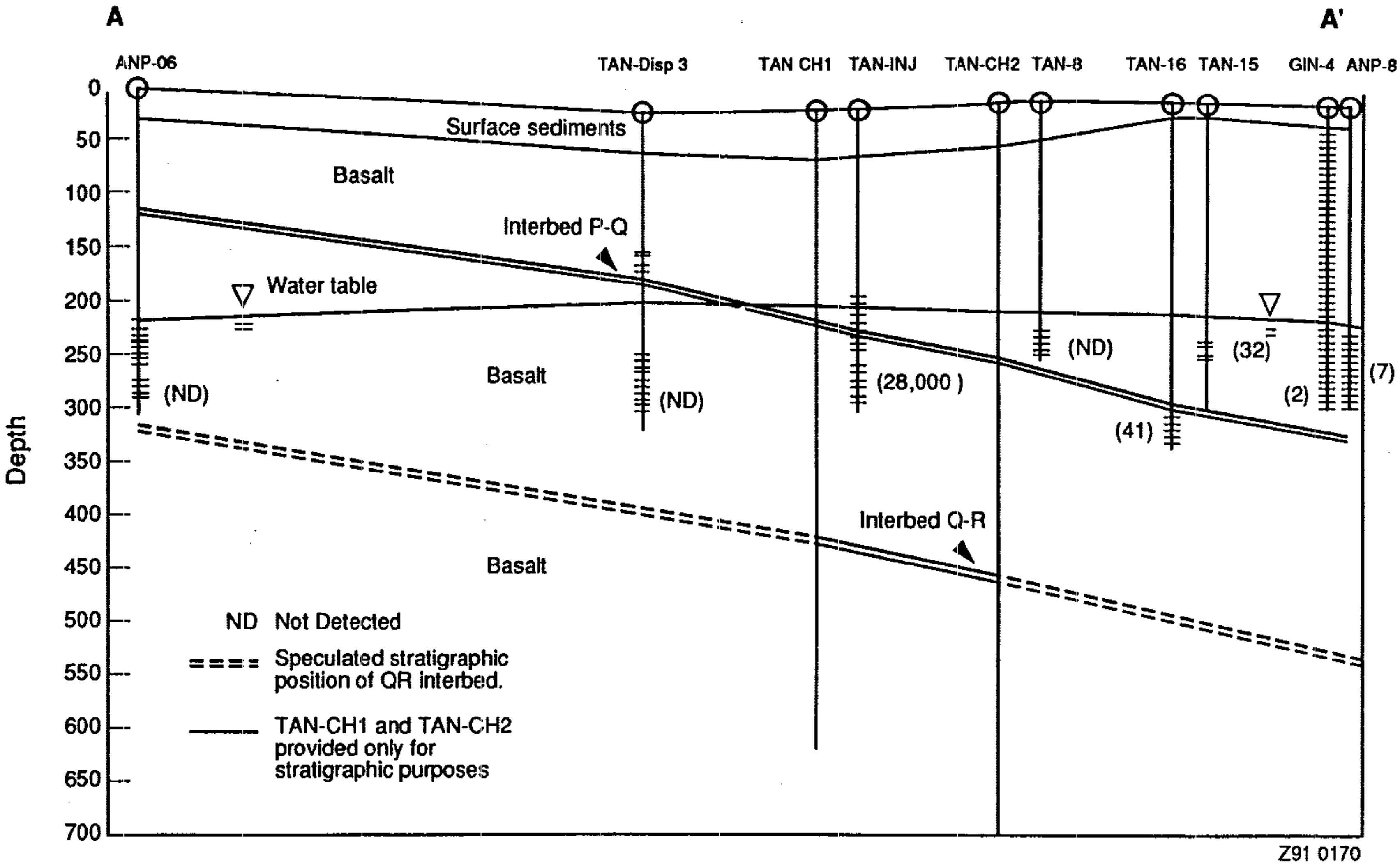


Figure 2-32. Northwest-southeast cross section through TAN showing completion intervals of wells and associated TCE concentration (μg/L) from the FY-90 sampling event.